User's Manual
for
TR PGM

Revision History:

Revision Number	Document Number	Date	Description
Rev 1.00	UMAN\TRS\0110	21-01-2010	First Release

Warranty Certificate

For New product: This product is warranted against defects in materials and workmanship for a period of 12 months from the date of shipment to Buyer.

For Rectified Products: Any product that will be replaced will have Warranty for 6 months or upto Original Product Warranty period whichever is greater.

The warranty is limited to repair or replacement of the defective unit at the option of the manufacturer. This warranty is void if the product has been altered, misused, dismantled, or otherwise abused.

ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, ARE EXCLUDED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

MAINTENANCE & SERVICE : There are no parts that can be serviced by the user. Service should be performed on a unit substitution basis only. Do not attempt to remove, replace or service any printed circuit board, components or any hardware/software related with display product. If problem within the display product occurs, contact the factory for service information or repair.

NOTE : Manufacturing unit is dedicated to providing complete customer service and customer satisfaction. If you have any comments or criticisms about how to improve the product features/reliability, please make a note of the problem/improvement and notify us. We are always open to new ideas and improvements. So please let us know your ideas and comments.

IMPORTANT

TR Series Products are Programmable Logic Controller modules which actually take control actions. It is assumed that the user is well acquainted with the PLC system being used and Windows based software usage, in general. Never use TR units to perform emergency STOP applications. It is advised that separate switches be used outside the PLC for ANY emergency Stops.

Any Mechanical or Electrical Modification to this Unit will void all Warranties.

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INTRODUCTION

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1.1 Purpose of this manual

Thank you for purchasing TR Series Products. TR Series Products are versatile high-performance programmable controllers with Microsoft® Windows based configuration Software.

This Manual explains the operation of the TR Series and how to implement available features using the TR PGM Software. This manual will help you to install, configure and operate your TR product.

1.1.1 TR Basics

TRs provide much more versatility than traditional programmable controllers. TR unit supports basic relay ladder functions. In addition to this it provides functions such as data operations, arithmatic operations, various functions etc. Furthermore, its high speed counter functions, pulse output functions, and data communication functions allow its application to a wide scope of control systems.

What is a *Project*?

A project is an user created application in TR PGM Software. A project contains information such as TR model, Network Configuration, ladder information, etc.

What is a *Ladder*?

You use Ladder Logic to write your project application. Ladder is based on Boolean principals. Ladder Diagrams are composed of different types of contact, coil and function block elements. These elements are placed in nets.

In any Ladder Diagram, the contacts represent input conditions. They lead power from the left rail to the right rail. Coils represent output instructions. In order for output coils to be activated, the logical state of the contacts must allow the power to flow through the net to the coil.

1.1.2 Hardware Requirements

The following basic PC hardware configuration is needed to configure and operate your TR PGM Configuration Software.
Minimal PC configuration for Windows2000 / XP:

DEVICE	RECOMMENDED
Processor	800MHz Pentium processor OR euivalent processor
Operating System	Microsoft Windows 2000 with SP4 Microsoft Windows XP Professional / Home Edition with SP2
RAM	256MB
Hard Disk Space	800MB (including 200MB for the .NET Framework Redistributable)
Display	1024 x 768 High Color 16-bit
Mouse/Keyboard	Required

Minimal PC configuration for Vista:

DEVICE	RECOMMENDED
Processor	1GHz Pentium processor or equivalent processor
Operating System	Microsoft Windows Vista Home and Vista Business edition
RAM	1GB
Hard Disk Space	800MB (including 200MB for the .NET Framework Redistributable)
Display	1024 x 768 High Color 16-bit
Mouse/Keyboard	Required

These are the minimum system requirements for a computer running the TR PGM Configuration software.

1.2 Features

Expansion Models:

Both Analog and Digital type expansion modules can be connected to TR series PLCs.

Built-in high speed counter:

Two single-phase or one quadrature (2-phase) pulses can be counted. The acceptable pulse rate is up to 5 kHz. (DC input type for quadrature only)

High speed processing:

Sophisticated machine control applications require high speed data manipulations. The TR is designed to meet these requirements.

· 1.4 ms per contact · 2.3 ms per coil

· 4.2 ms per 16-bit transfer · 6.5 ms per 16-bit addition

The TR also supports interrupt input function (DC input type only). This allows immediate operation independent of program scan.

High performance software:

The TRs offer various basic ladder instructions and other functional instructions. Subroutines, Interrupt functions, Indirect addressing, For/Next loops, Pre-derivative real PID, etc. are standard on the TR unit. These functions allow the unit to be applied to the most demanding control applications.

Pulse output / PWM output:

One point of variable frequency pulses (max. 5 kHz) or variable duty pulses can be output. These functions can be used to drive a stepping motor or to simulate an analog output. (DC input type only)

Sampling trace function:

The sampling trace is the function to collect the user specified data every user specified timing (minimum every scan), and to display the collected data on the programmer screen in time chart and/or trend graph format. This function is useful for checking the input signals changing.

Removable terminal blocks:

The TRs are equipped with removable terminal blocks. This supports the easy maintenance work.

On-line program changes:

Real-time clock/calendar function:

The TR has the real-time-clock/calendar function (year, month, day, day of the week, hours, minutes, seconds) that can be used for performing scheduled operations, data gathering with time stamps, etc. The real-time-clock/calendar data is backed up by a removable and replacable battery.

RS-485 multi-purpose communication port:

The TR unit has an RS-485 multi-purpose communication port. Using this port, one of the following communication modes can be selected.

Computer link mode: T-series computer link protocol can be used in this mode. Up to 32 TR can be connected to a master computer. By using this mode, MMI/SCADA system can be easily configured.

Data link mode: Two PLCs can be directly linked together. This direct link is inexpensive, easily configured and requires no special programming.

Free ASCII mode: User defined ASCII messages can be transmitted and received through this port. A terminal, printer, bar-code reader, or other serial ASCII device can be directly connected.

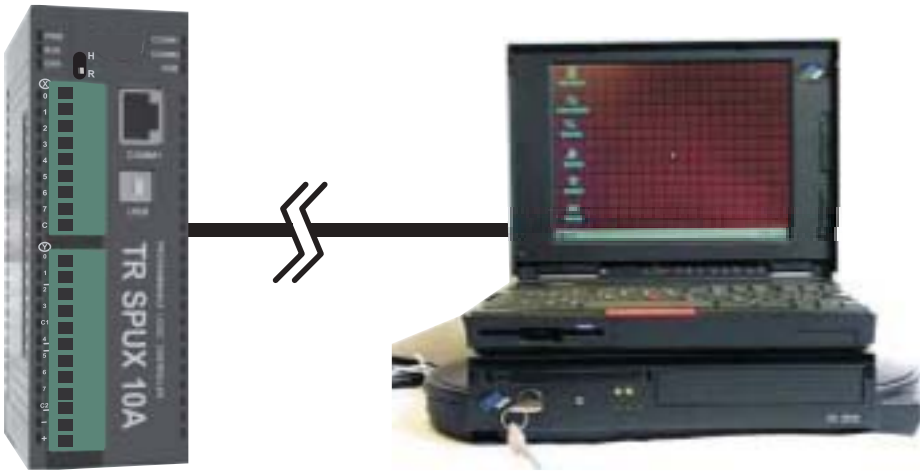
1.3 TR Overview

1.3.1 What is a TR series unit?

TR Series units are compact, easy-handling block style programmable controller. It also has modular expandability. Programming instructions are upward compatible in this series of programmable controllers.

Configuration of TR unit:

Each TR unit has to be configured using the TR PGM Software before connecting it to the PLC.

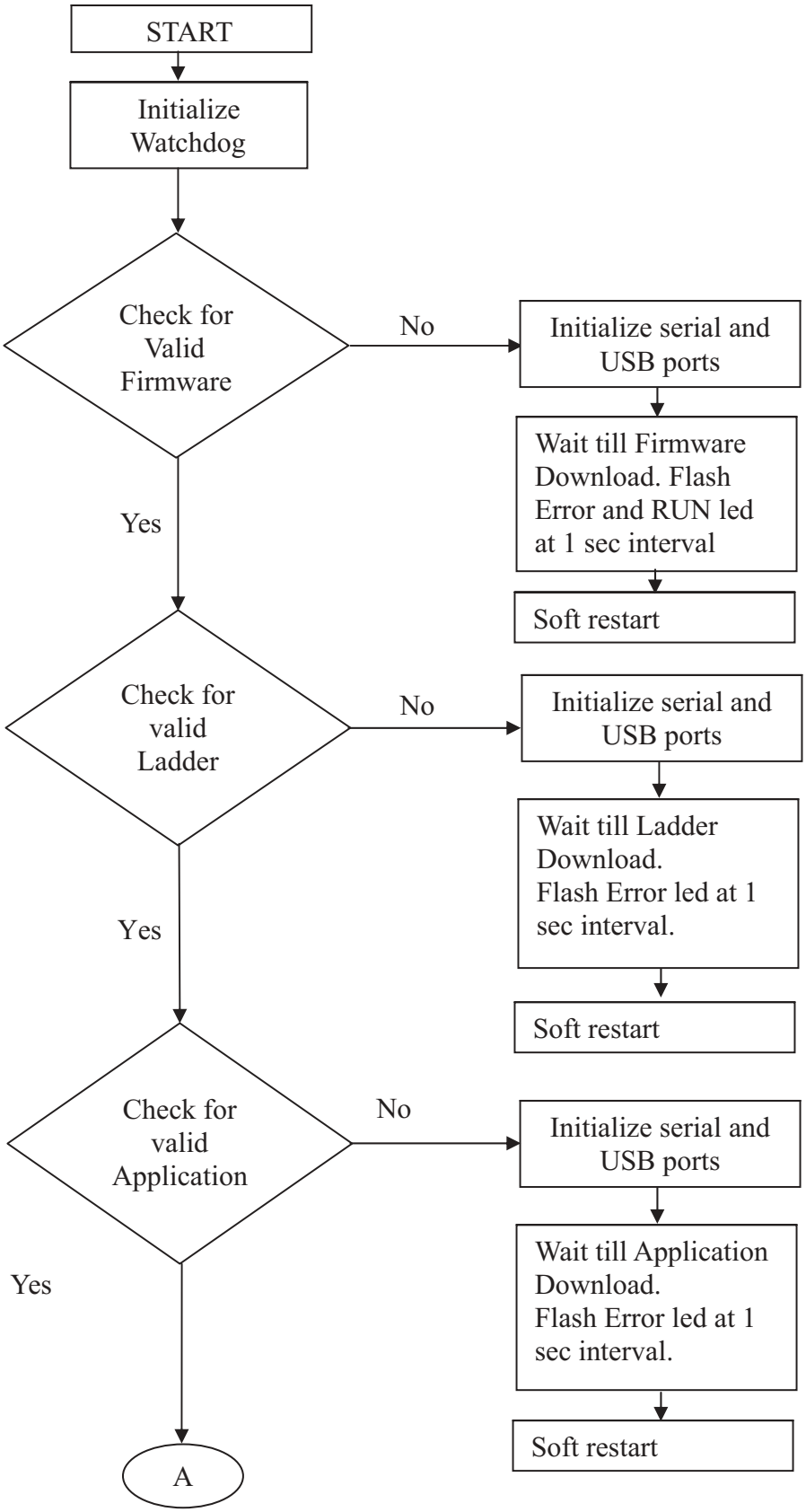


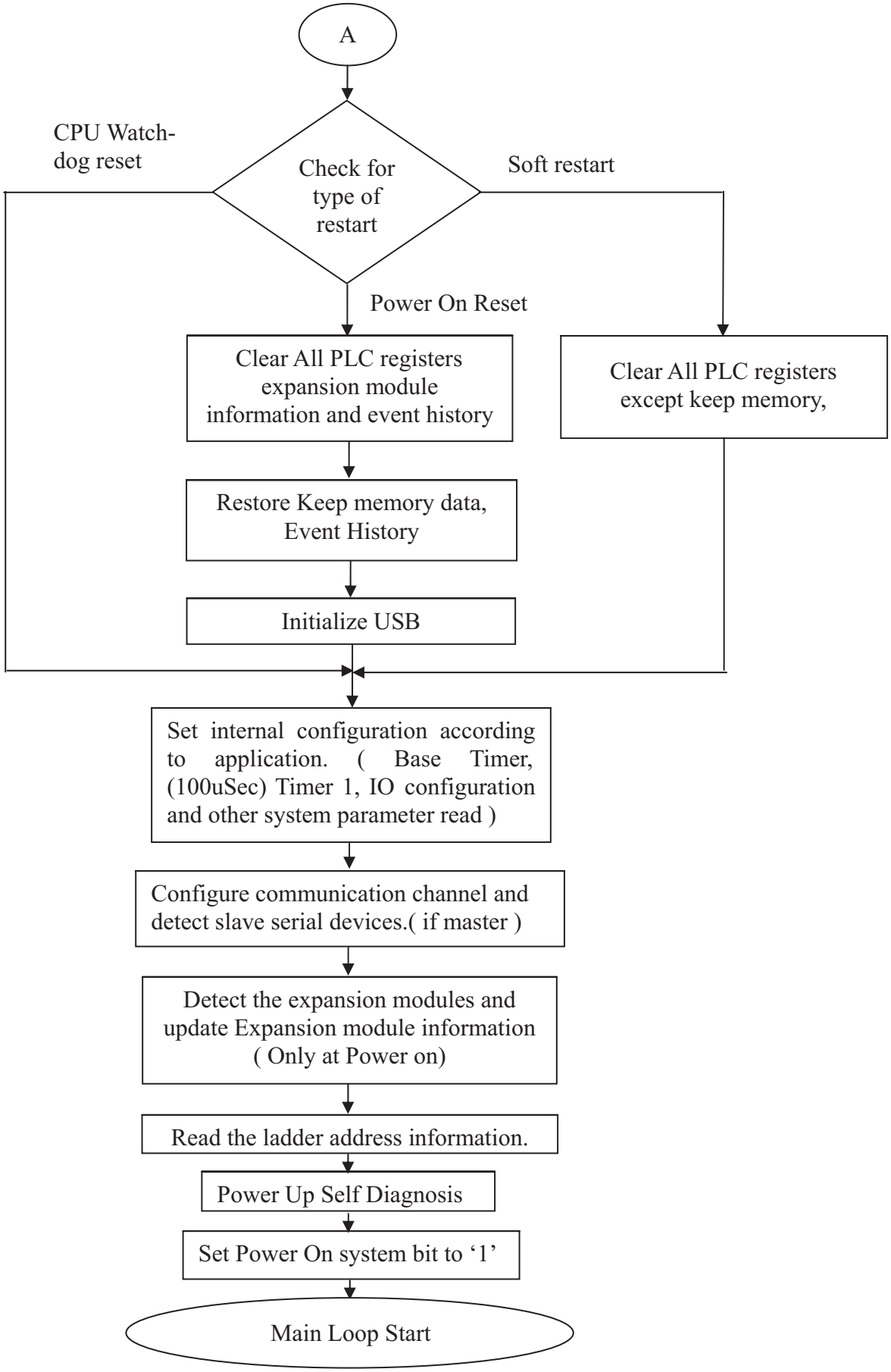
Normal Operation:

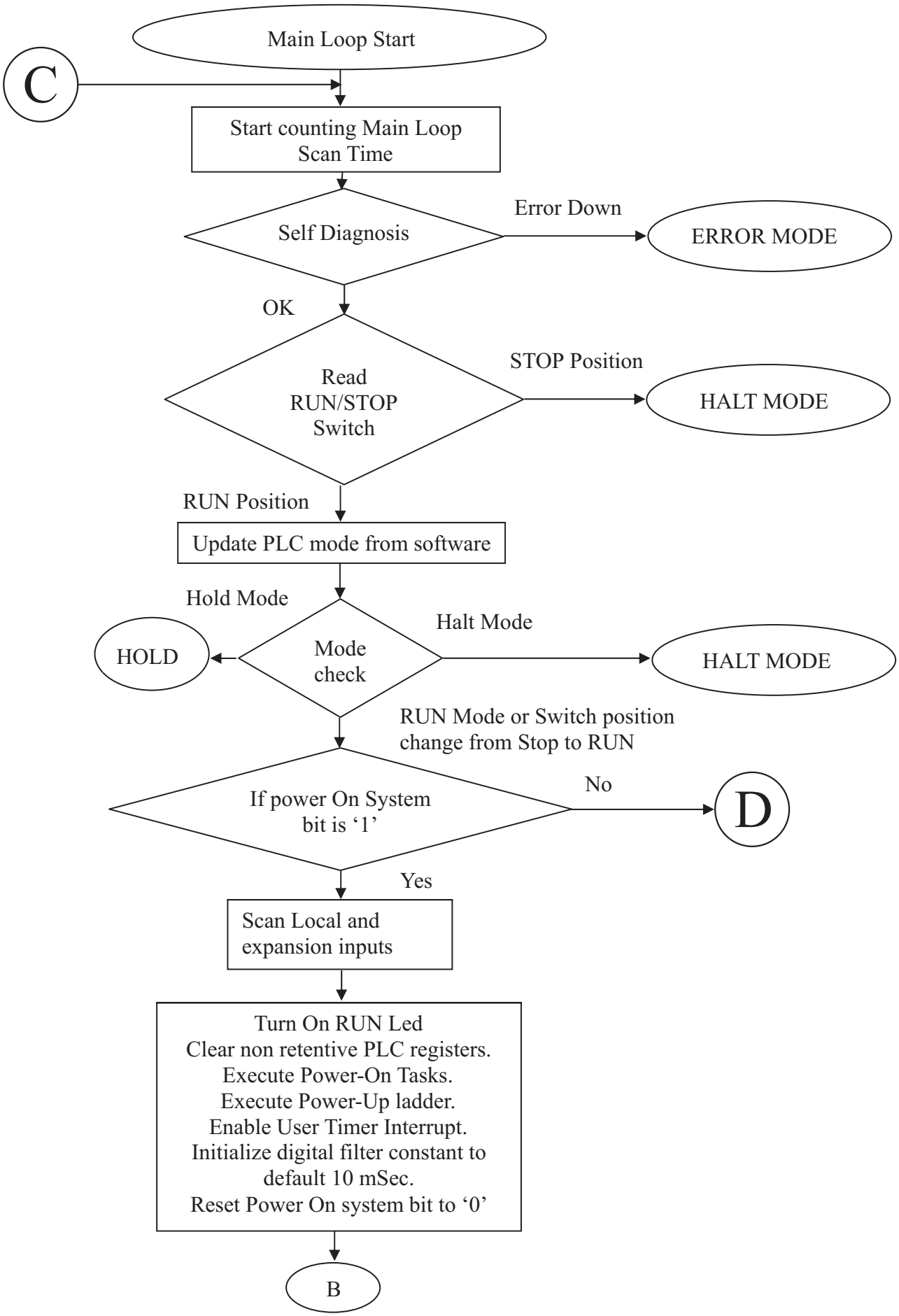
Connect TR unit to PLC using the correct PLC-Unit cable.

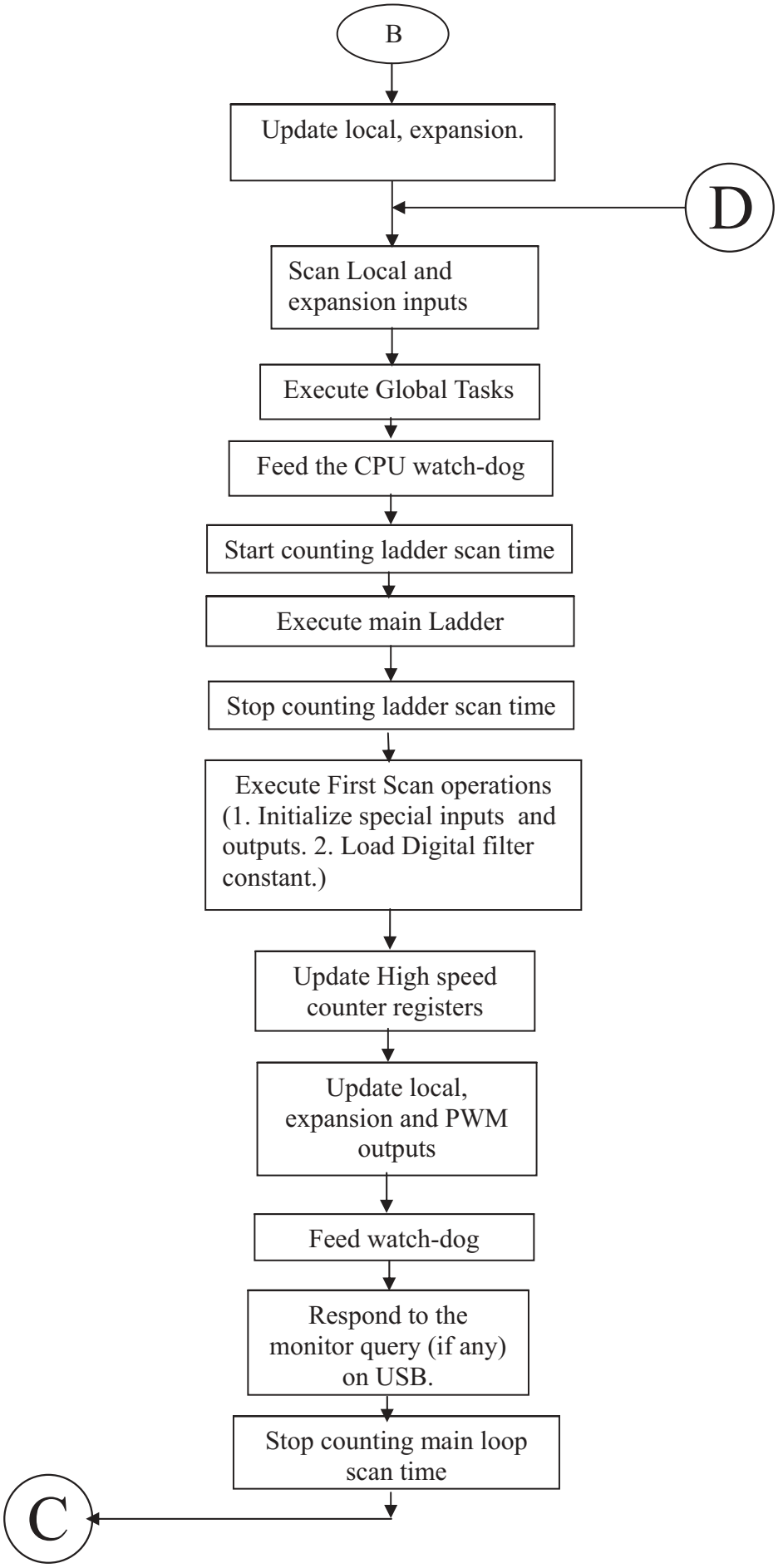
1.3.2 How TR Works?

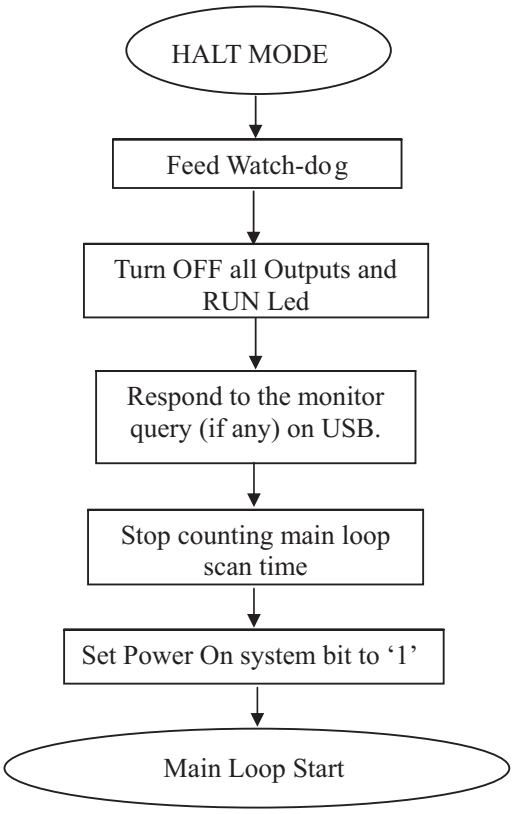
The TR follows a specific sequence and the sequence is as shown below:

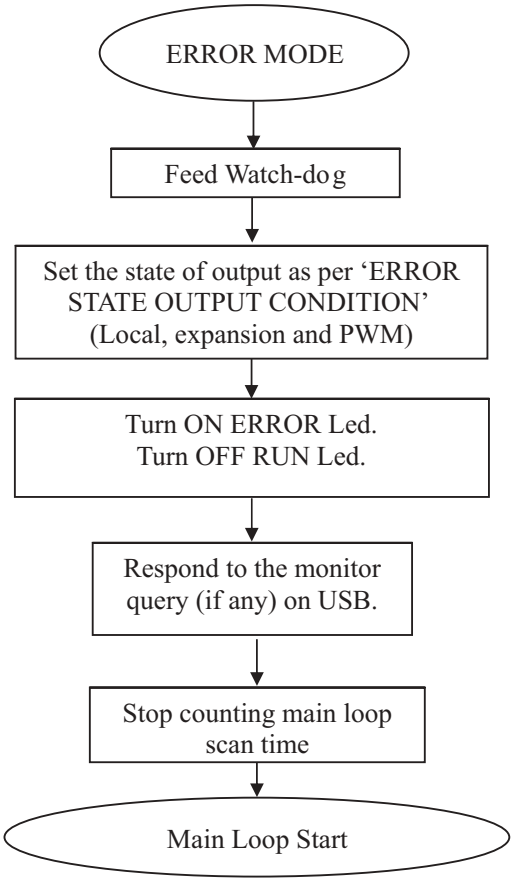


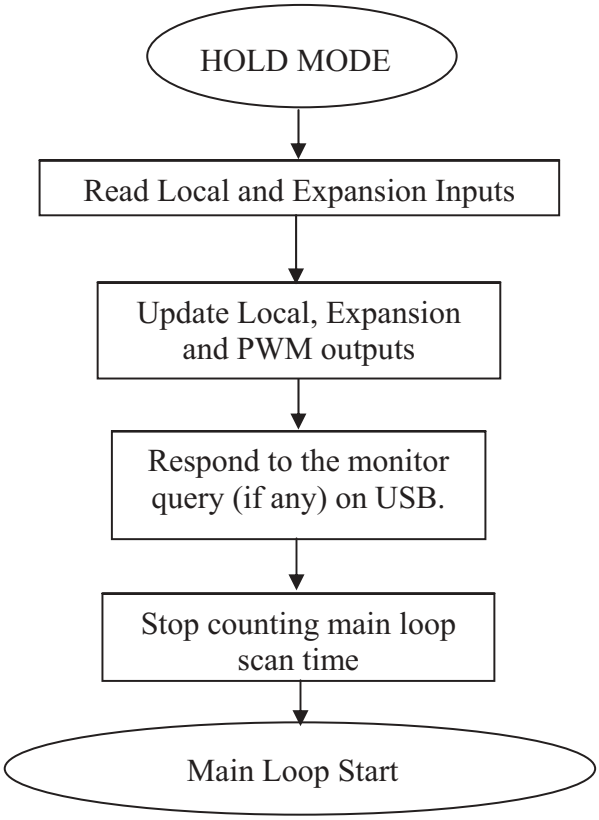

A
CPU Watch-dog reset
Check for type of restart
Soft restart
Power On Reset
Clear All PLC registers expansion module information and event history
Clear All PLC registers except keep memory,
Restore Keep memory data, Event History
Initialize USB
Set internal configuration according to application. (Base Timer, (100uSec) Timer 1, IO configuration and other system parameter read)
Configure communication channel and detect slave serial devices.(if master)
Detect the expansion modules and update Expansion module information (Only at Power on)
Read the ladder address information.
Power Up Self Diagnosis
Set Power On system bit to '1'
Main Loop Start

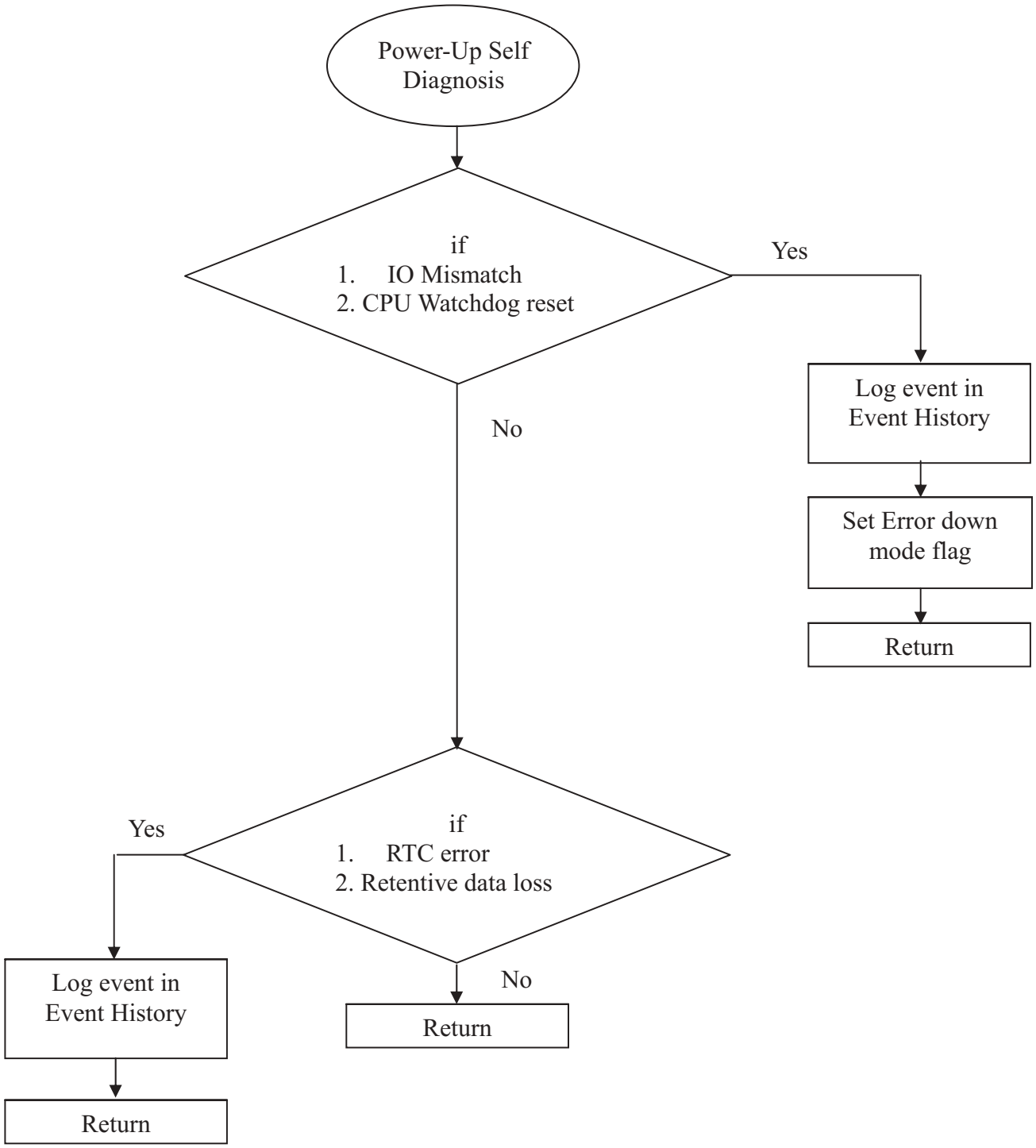

Main Loop Start
C
Start counting Main Loop Scan Time
Self Diagnosis
Error Down
ERROR MODE
OK
Read RUN/STOP Switch
STOP Position
HALT MODE
RUN Position
Update PLC mode from software
Hold Mode
HOLD
Mode check
Halt Mode
HALT MODE
RUN Mode or Switch position change from Stop to RUN
If power On System bit is '1'
No
D
Yes
Scan Local and expansion inputs
Turn On RUN Led
Clear non retentive PLC registers.
Execute Power-On Tasks.
Execute Power-Up ladder.
Enable User Timer Interrupt.
Initialize digital filter constant to default 10 mSec.
Reset Power On system bit to '0'
B

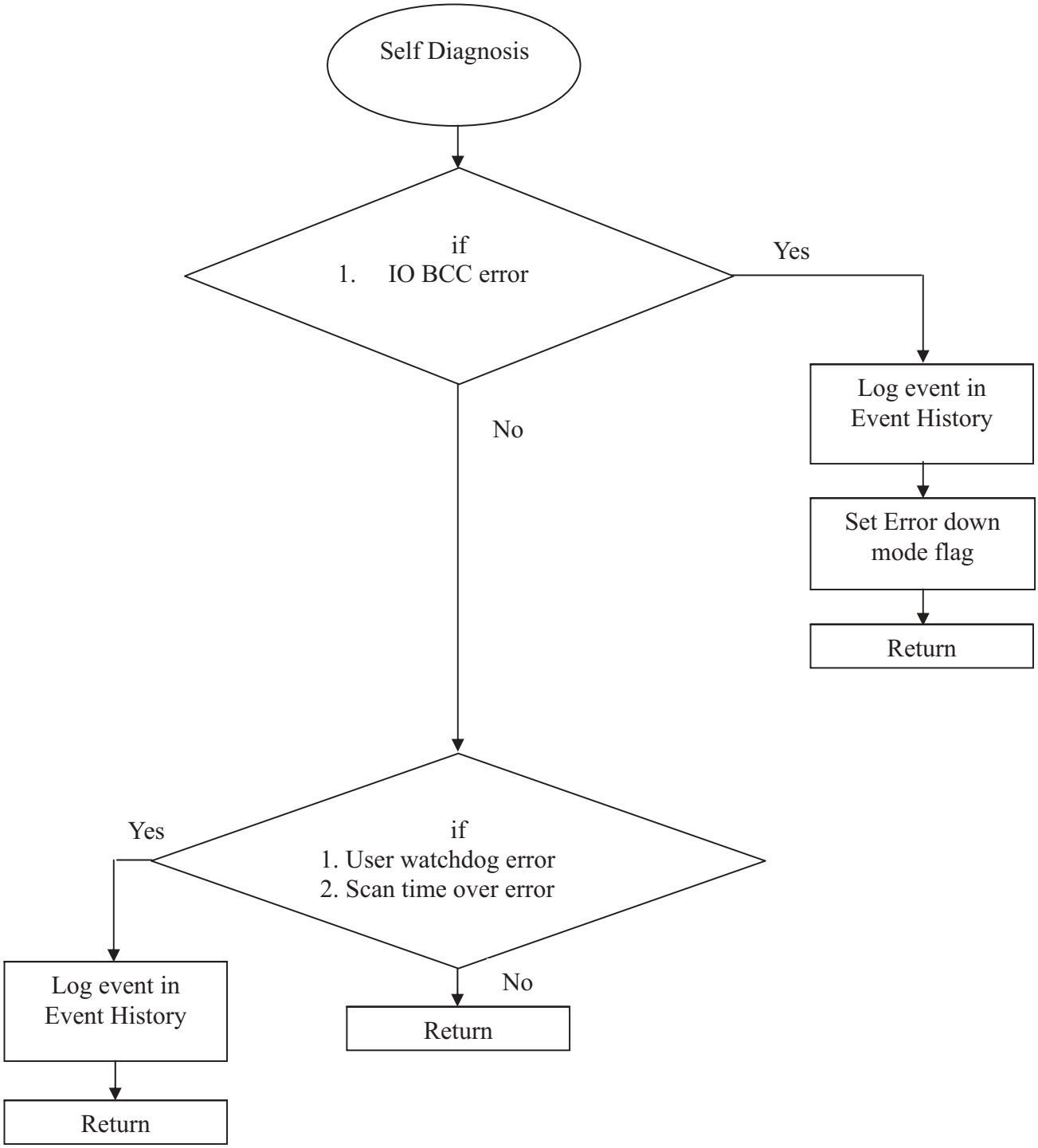

B
Update local, expansion.
D
Scan Local and expansion inputs
Execute Global Tasks
Feed the CPU watch-dog
Start counting ladder scan time
Execute main Ladder
Stop counting ladder scan time
Execute First Scan operations (1. Initialize special inputs and outputs. 2. Load Digital filter constant.)
Update High speed counter registers
Update local, expansion and PWM outputs
Feed watch-dog
Respond to the monitor query (if any) on USB.
Stop counting main loop scan time
C


HALT MODE
Feed Watch-dog
Turn OFF all Outputs and RUN Led
Respond to the monitor query (if any) on USB.
Stop counting main loop scan time
Set Power On system bit to '1'
Main Loop Start


ERROR MODE
Feed Watch-dog
Set the state of output as per 'ERROR STATE OUTPUT CONDITION' (Local, expansion and PWM)
Turn ON ERROR Led.
Turn OFF RUN Led.
Respond to the monitor query (if any) on USB.
Stop counting main loop scan time
Main Loop Start


HOLD MODE
Read Local and Expansion Inputs
Update Local, Expansion and PWM outputs
Respond to the monitor query (if any) on USB.
Stop counting main loop scan time
Main Loop Start


Power-Up Self Diagnosis
if
1. IO Mismatch
2. CPU Watchdog reset
Yes
Log event in Event History
Set Error down mode flag
Return
No
if
1. RTC error
2. Retentive data loss
Yes
Log event in Event History
Return
No
Return


Self Diagnosis
if
1. IO BCC error
Yes
Log event in
Event History
Set Error down
mode flag
Return
No
Yes
if
1. User watchdog error
2. Scan time over error
Log event in
Event History
Return
No
Return

1.4 Specifications of TR Series

The TR series models possess powerful programmable logic features. User can implement logic, specific to application using standard Ladder programming.

TR models need +24VDC power from an external supply.

Models included in the TR Series are as follows:

Basic Models:

TRSPUX10A	PLC Base Model with I/Os and serial port
TRSPUX10E	PLC Base Model with serial port and Ethernet

Expansion models:

TRSDIX1600	16 Input Digital Module
TRSDOX0016P	16 PNP type transistor output digital module
TRSDOX0016N	16 NPN type transistor output digital module
TRSROX0016	16 Relay type output digital module
TRSDIO0808P	8 Digital input, 8 PNP type transistor output digital module
TRSDIO0808N	8 Digital input, 8 NPN type transistor output digital module
TRSDRO0808	8 Digital input, 8 Relay type output digital module
TRSADX0800	0-10 VDC or 4-20 mA (16 Bit), 8 channels input.
TRSRTX0800	RTD PT100 (16 Bit), 8 channels input.
TRSDAX0004	0-10 VDC or 4-20 mA (16 Bit) Output.
TRSAIO0402	4 Universal Analog Inputs (RTD PT100, TC, 4-20 mA, 0-20mA, 0-50mV, 0 - 100mV, 0-10VDC), 2 Voltage (0-10V) / Current (4-20mA) outputs

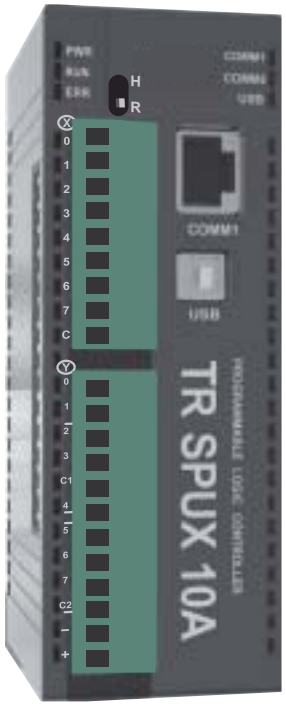
1.4.1 Comparison between basic models (TRSPUX10A & TRSPUX10E)

Functional Specific.	TRSPUX10A	TRSPUX10E
Ladder Program Memeory	8K Steps	8K Steps
Expansion I/O capacity	Maximum 8 expansion modules	Maximum 8 expansion modules
Expansion Bus	SPI (1MHz)	SPI (1MHz)
Local I/Os	16 (8 IN / 8 OUT).	---
Processing time	1 uSec. for NO/NC	1 uSec. for NO/NC
Input registers	400 Words Max.	400 Words Max.
Output registers	400 Words Max.	400 Words Max.
Data registers	4096 words	4096 words
Retentive registers	1400 words (EEPROM)	1400 words (EEPROM)
System registers	256 words	256 words
Configuration Register	1600 words Max.	1600 words Max.
Timer Registers	256 words	256 words
Counter Registers	256 words	256 words
Timer Devices	256 points	256 points
Counter Devices	256 points	256 points
HS Counter	2 HS counter inputs, single phase. (100KHz). 32 bit.	---
System Coil	100 points	100 points
Communication ports	2 COM ports. COM1: RS232 and RS485. COM2: 2-wire RS-485 One USB port for programming.	2 COM ports. COM1: RS232 and RS485. COM2: 2-wire RS-485 One USB port for programming.
Ethernet	-	10/100 Mbps ethernet port
Power Supply Spec.:		
Supply Voltage	24VDC, +/-15%	24VDC, +/-15%
Maximum Input current	150mA at 24VDC (Without expansion)	330mA at 24VDC (Without expansion)
Inrush Current	8A at 24VDC (Without expansion)	8A at 24VDC (Without expansion)
Dielectric Strength (PS and internal circuit)	1500 VDC, 1 minute	1500 VDC, 1 minute
Insulation Resistance (PS and internal circuit)	Minimum 10M ohm	Minimum 10M ohm

1.4.2 Specification for Basic Models

TRSPUX10A

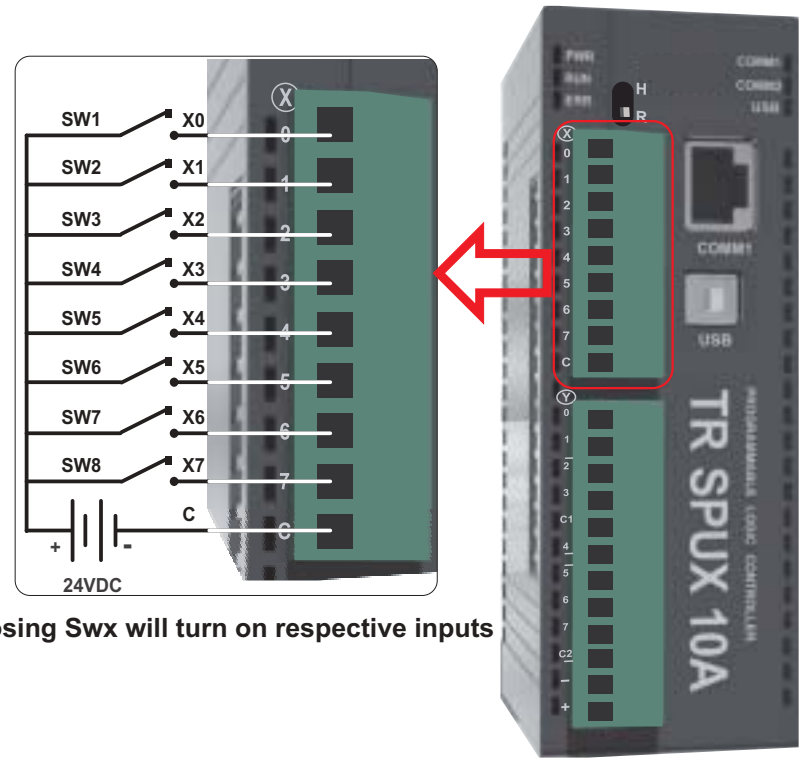
Power Supply	24VDC
Voltage Rating	24 VDC ± 15%
Power Rating	1.5W (Without expansion) @ 24VDC
Inrush Current	8A (Without expansion) @ 24VDC
Approvals	CE, UL
Memory	
Total Program Memory	8K Steps
User Data	
Input Registers	400 Words / 6400 pts. (Max.*)
Outout Registers	400 Words / 6400 pts. (Max.*)
Data Registers	4096 words
Retentive Registers	1400 words (EEPROM)
System Registers	256 words
Timer Registers	256 words
Counter Register	256 words
Timer Devices	256 points
System Devices	100 points
Counter Devices	256 points
Configuration Register	1600 Words / 25600 pts. (Max.*)
Communication Ports	
2 COM Ports:	COM1: RS232 and RS485 COM2: 2-wire RS485
1 USB:	For programming
IO Specifications:	
Expansion IO capacity	8 expansion modules
Expansion Bus	SPI (1 MHz)
Local IOs	16 (8 IN / 8 OUT)
Digital Inputs	8 Unidirectional Digital inputs (2 High Speed inputs of upto 100KHz). 8 points per common.
Rated Input voltage	24VDC
Rated Input Current	Upto 5mA. (12mA for High Speed I/Ps)
Input Impedance	5.4Kohm (2.2Kohm for High Speed i/ps)
Minimum ON voltage	9.6 VDC
Maximum OFF voltage	3.6 VDC
Turn ON time	10 msec
Turn OFF time	10 msec
Isolation	Optically isolated from internal circuit
Digital outputs	6 Relay (Form A) outputs. 3 points per common. 2 Transistor Output
Output Capacity	2A per o/p for Relay (6A per common), 0.5 A for transistor
Rated load	230V / 2A, 30VDC / 2A for Relay, 0.5 A at 24VDC for transistor



Special Input Function	
HS Counter	2HS Counter inputs, single phase (100 KHZ), 32 Bit Dual Phase 1X, 2X, 4X (5KHz)
Interrupt Input	2 Points
PWM Output	CW / CCW OR PLS / DIR
Connection method	Removable terminals (3.81mm pitch)
General	
Operating Temperature	0 to 55 deg.C.
Storage Temperature	-20 to 85 deg.C.
Operating Humidity	10% to 90% (Non condensing)
Vibration Tests	Frequency 10Hz to 150hz Displacement +/- 0.35mm Crossover frequency 59Hz Acceleration: 2g Sweep rate : 1 octave per min Duration : 20 Sweeps / Axis app (2Hr 30min) Axis , X,Y, Z
Shock Test	25 g acceleration with 11 ms 3 Shocks each **AXIS** (a total of 18 Shocks)
Mechanical Dimension	100mm X 35mm X 70mm
Weight	200 gm.

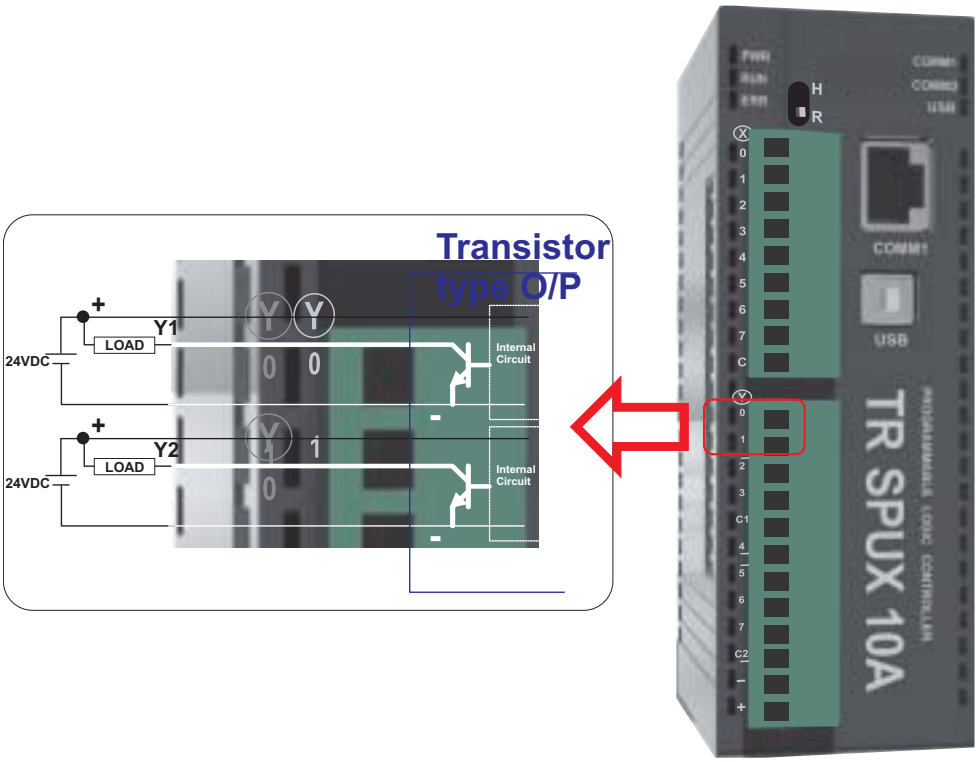
Note:
* : Depends upon I/O allocation.

Wiring Diagram for Digital I/Ps and O/Ps of model TRSPUX10A:
1. Wiring diagram for testing digital inputs:
Note: X0 and X1 are high speed input

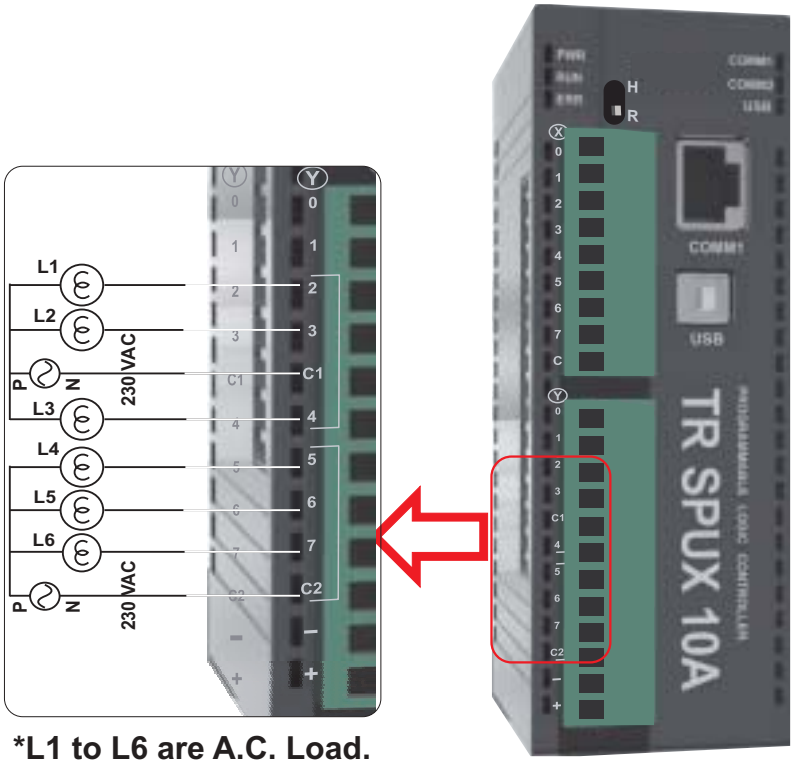


Closing Swx will turn on respective inputs

Wiring for transistor type outputs:



Wiring for output connections:



***L1 to L6 are A.C. Load.**

TRSPUX10E

Power Supply	24VDC
Voltage Rating	24 VDC ± 15%
Power Rating	2W (Without expansion) @ 24VDC
Inrush Current	8A (Without expansion) @ 24VDC
Standards	CE
Memory	
Total Program Memory	8K Steps
User Data	
Input Registers	400 Words / 6400 pts. (Max.*)
Outout Registers	400 Words / 6400 pts. (Max.*)
Data Registers	4096 words
Retentive Registers	1400 words (EEPROM)
System Registers	256 words
Timer Registers	256 words
Counter Register	256 words
Timer Devices	256 points
System Devices	100 points
Counter Devices	256 points
Configuration Register	1600 Words / 25600 pts. (Max.*)
Communication Ports	
2 COM Ports:	COM1: RS232 COM2: 2-wire RS485
1 USB:	For programming
1 Ethernet:	10/100 MBBS For PLC communication and Configuration
IO Specifications:	
Expansion IO capacity	8 expansion modules
Expansion Bus	SPI (1 MHz)
Local I/Os	None
General	
Mechanical Dimension	100mm X 35mm X 70mm
Weight	200 gm.

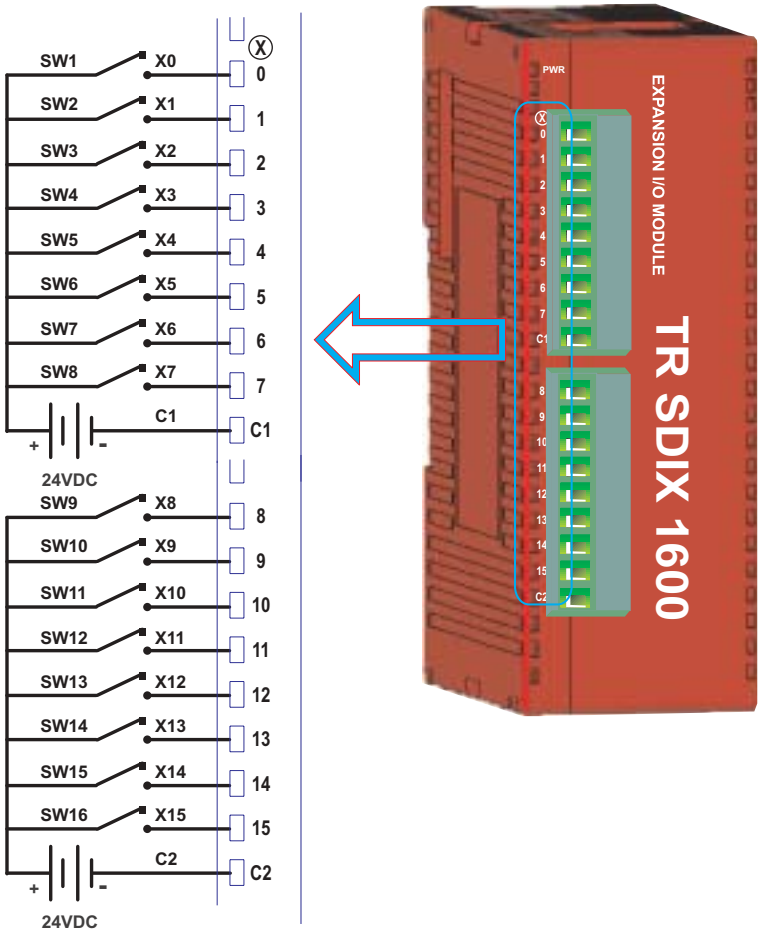
Note:
* : Depends upon I/O allocation.

1.4.4 Specification for Expansion Models TRSDIX1600

Digital Inputs	16 Normal Inputs, 8 points per common. Bidirectional type.
Rated Input voltage	24VDC
Rated Input Current	Upto 5mA
Input Impedance	5.4K ohm
Minimum ON voltage	9.6 VDC
Maximum OFF voltage	3.6 VDC
Turn ON time	10 msec
Turn OFF time	10 msec
Isolation	Digital inputs are optically isolated from the internal circuit
Connection method	Removable terminals (3.81mm pitch)
Digital outputs	0
General	
Mechanical Dimension	100mm X 35mm X 70mm
Weight	150 gm.

Power Rating (Back Plane)	
Voltage Rating	3.75 VDC derived from base model
Current Rating	Upto 80mA

Wiring Diagram for TRSDIX1600



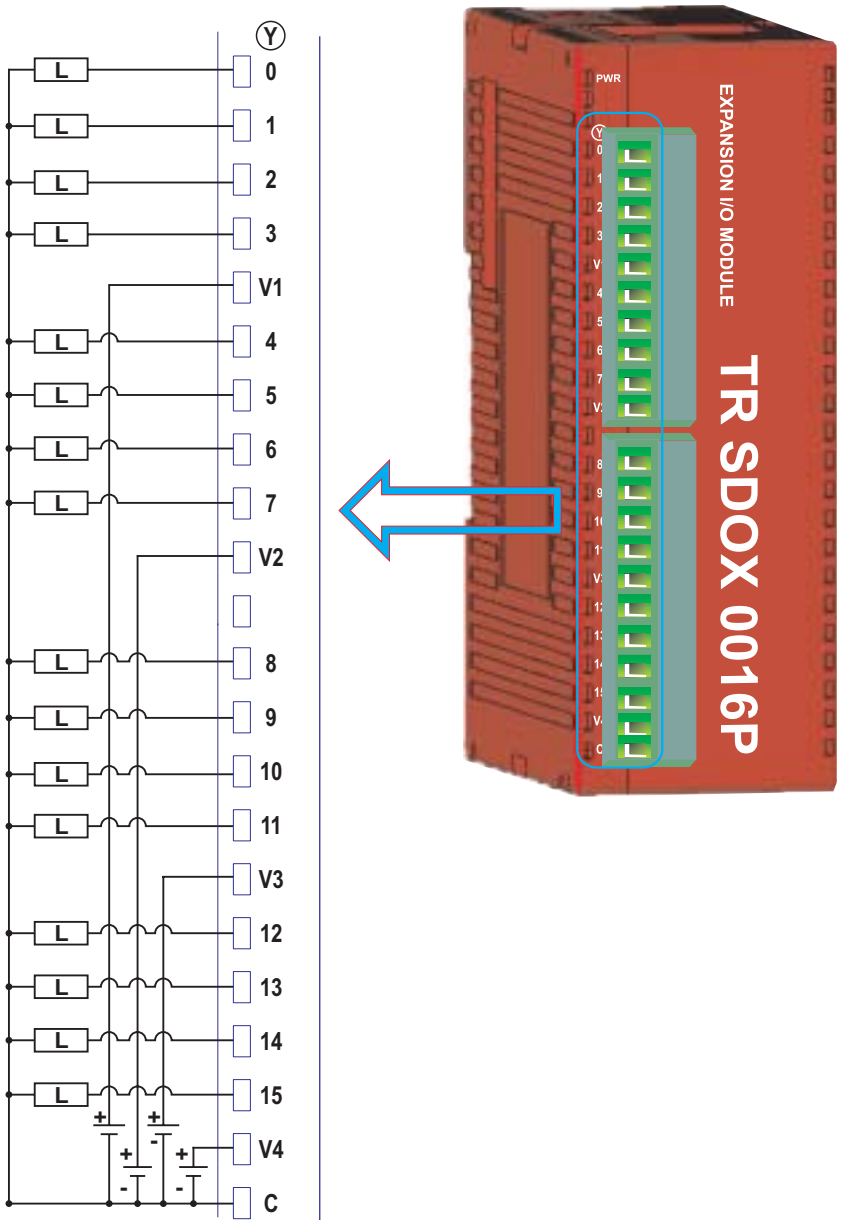
Closing Swx will turn on respective inputs

TRSDOX0016P (PNP Type transistor output)

Digital Inputs	0
Digital outputs	16 PNP type Transistor output. 4 points per common
Rated load	500mA max for PNP and NPN type transistor output
General	
Mechanical Dimension	100mm X 35mm X 70mm
Weight	150 gm.

Power Rating (Back Plane)	
Voltage Rating	3.75 VDC derived from base model
Current Rating	Upto 80mA

Wiring Diagram for TRSDOX0016P

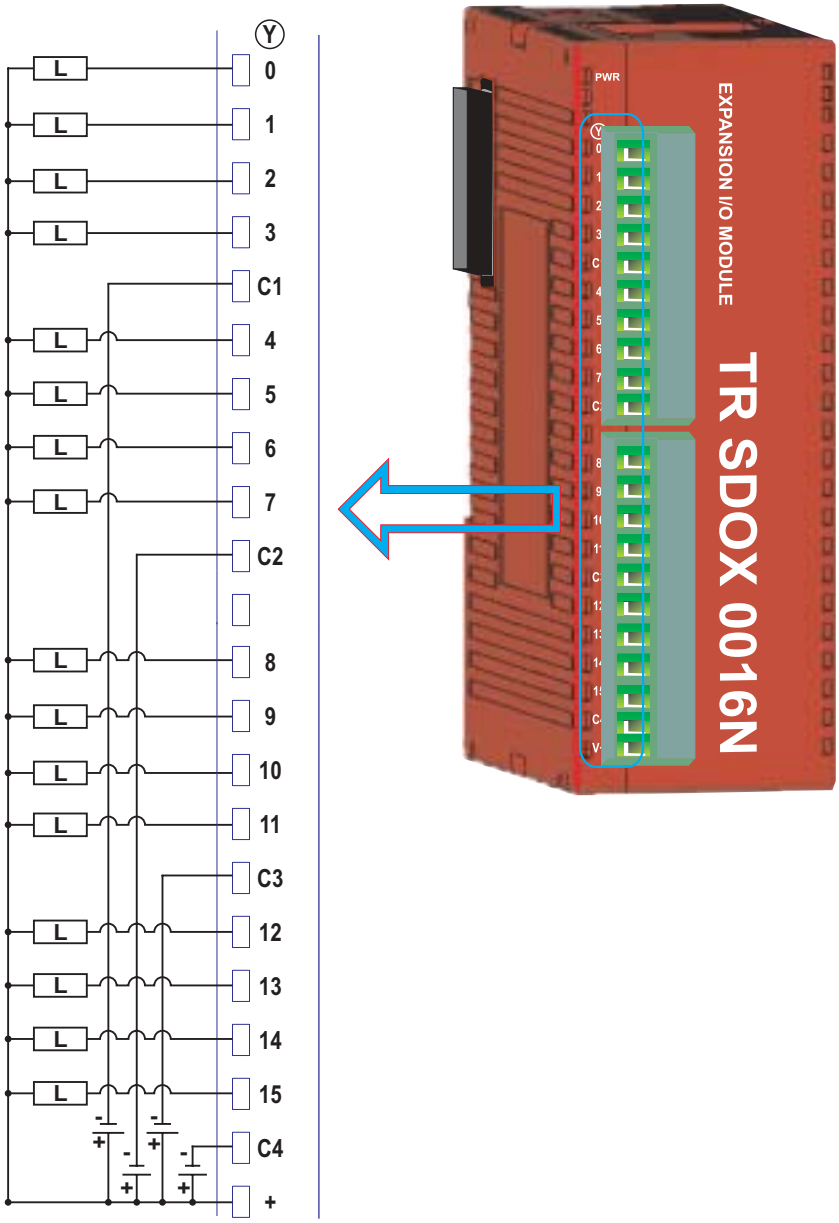


TRSDOX0016N (NPN Type transistor output)

Digital Inputs	0
Digital outputs	16 NPN type Transistor output. 4 points per common
Rated load	500mA max for PNP and NPN type transistor output
General	
Mechanical Dimension	100mm X 35mm X 70mm
Weight	150 gm.

Power Rating (Back Plane)	
Voltage Rating	3.75 VDC derived from base model
Current Rating	Upto 80mA

Wiring Diagram for TRSDOX0016N

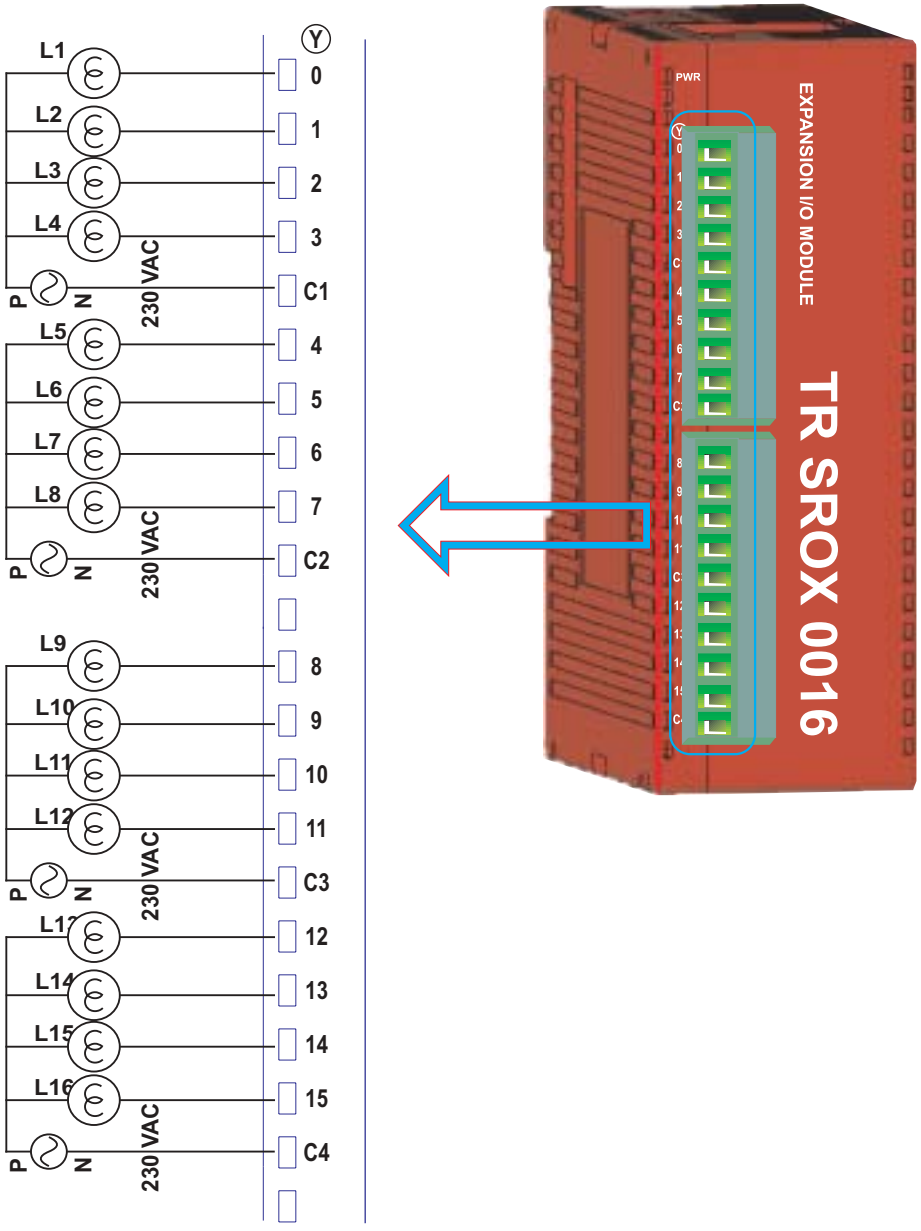


TRSROX0016 (Relay Type output)

Digital Inputs	0
Digital outputs	16 Relay (Form A) output. 4 points per common
Rated load	230V / 2A, 30VDC / 2A
General	
Mechanical Dimension	100mm X 35mm X 70mm
Weight	150 gm.

Power Rating (Back Plane)	
Voltage Rating	3.75 VDC derived from base model
Current Rating	Upto 80mA
Coil Supply:	
Voltage Rating	24 VDC +/-15%
Current Rating	Upto 200mA @ 24VDC

Wiring Diagram for TRSROX0016



***L1 to L16 are A.C. Load.**

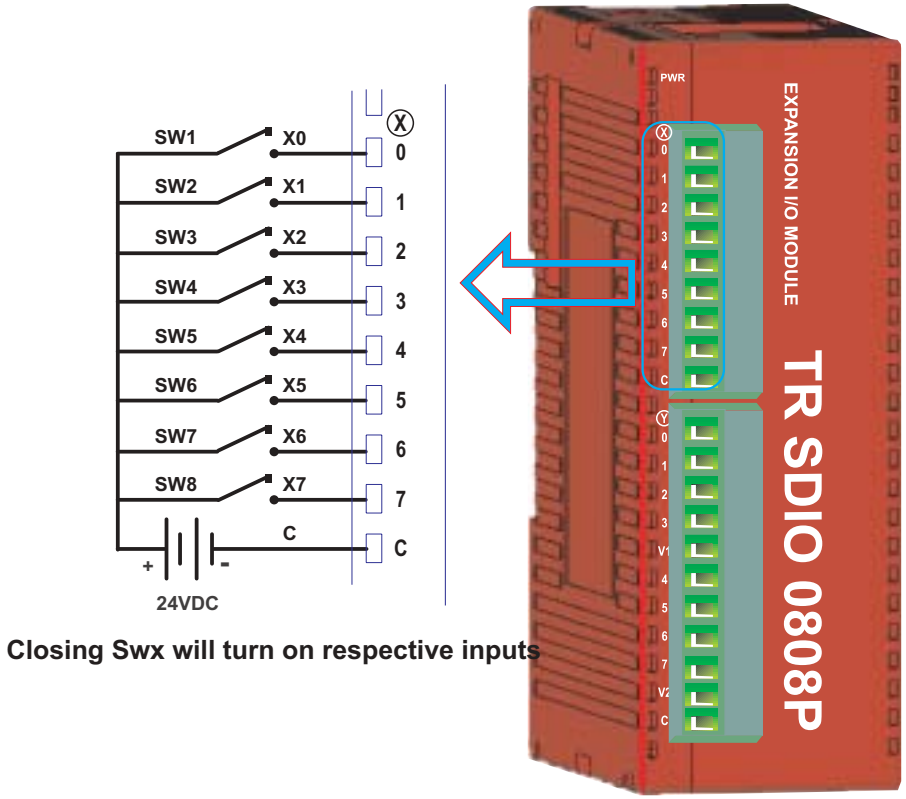
TRSDIO0808P (PNP Type transistor output)
TRSDIO0808N (NPN Type transistor output)
TRSDRO0808 (Relay Type transistor output)

Digital Inputs	8 Normal inputs 4 points per common. Bidirectional type.
Digital outputs	8 Relay (Form A) outputs. 4 points per common.
	8 PNP type Transistor output. 4 points per common.
	8 NPN type Transistor output. 4 points per common.
Rated Input voltage	24VDC
Rated Input Current	Upto 5mA
Input Impedance	5.4K ohm
Minimum ON voltage	9.6 VDC
Maximum OFF voltage	3.6 VDC
Turn ON time	10 msec
Turn OFF time	10 msec
Isolation	Optically isolated from the internal circuit
Connection method	Removable terminals (3.81mm pitch)
Output Capacity	2A per o/p. 8A per common for Relay type output
	500mA max for PNP and NPN type transistor output
Rated load	230V / 2A, 30VDC / 2A (for Relay), 500mA at 24VDC (for transistor)
General	
Operating Temperature	0 to 55 deg.C.
Storage Temperature	-20 to 85 deg.C.
Operating Humidity	10% to 90% (Non condensing)
Vibration	10Hz to 150Hz ,displacement of 0.2 mm (peak) (3 mutually perpendicular axes)
Shock	490.5 m/s2,2 half-sine shocks per axis, on 3 mutually perpendicular axes)
Mechanical Dimension	100mm X 35mm X 70mm
Weight	150 gm.
FTB (Fast Transient / Burst)	IEC61000-4-4 [2.2kV (Power- Direct Injection), 1.2KV (I/O - Capacitive clamp).]
Electrostatic discharge	IEC61000-4-2 Level 3
Electromagnetic field	IEC61000-4-3, 10 V/m AM modulation (80 MHz to 1 GHz)
RF Immunity	IEC61000-4-6, 10 V/m AM modulation (0.15MHz to 80 MHz)
Dumped Oscillatory wave	IEC61000-4-12
Surge Immunity	IEC61000-4-5 Level 2
Radiated emission	EN50081-2

Power Rating (Back Plane)	
Voltage Rating	3.75 VDC derived from base model
Current Rating	Upto 80mA
Coil Supply:	
Voltage Rating	24 VDC +/-15%
Current Rating	Upto 100mA @ 24VDC

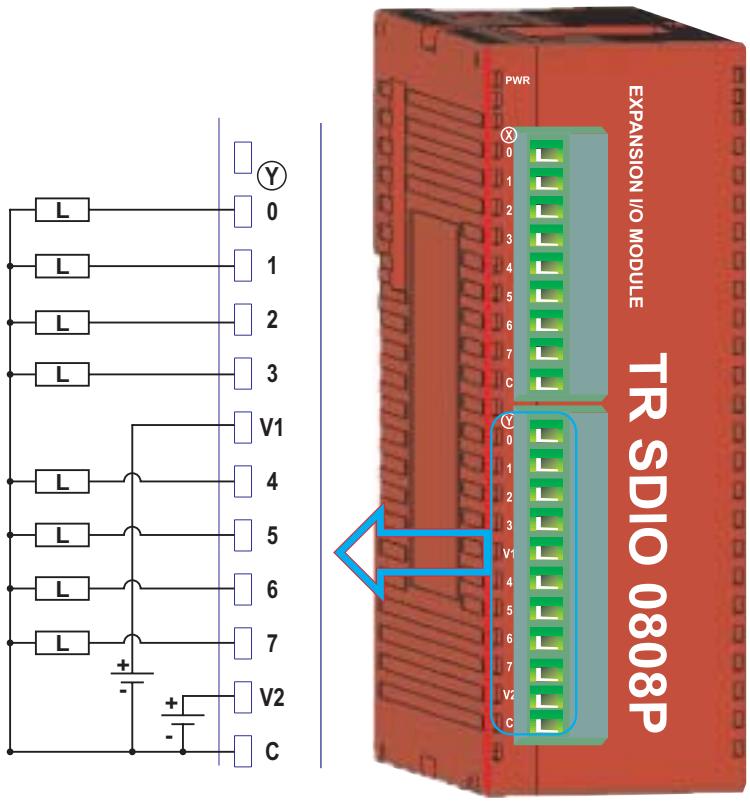
Wiring Diagram for TRSDIO0808P:

1. Wiring diagram for testing digital inputs:



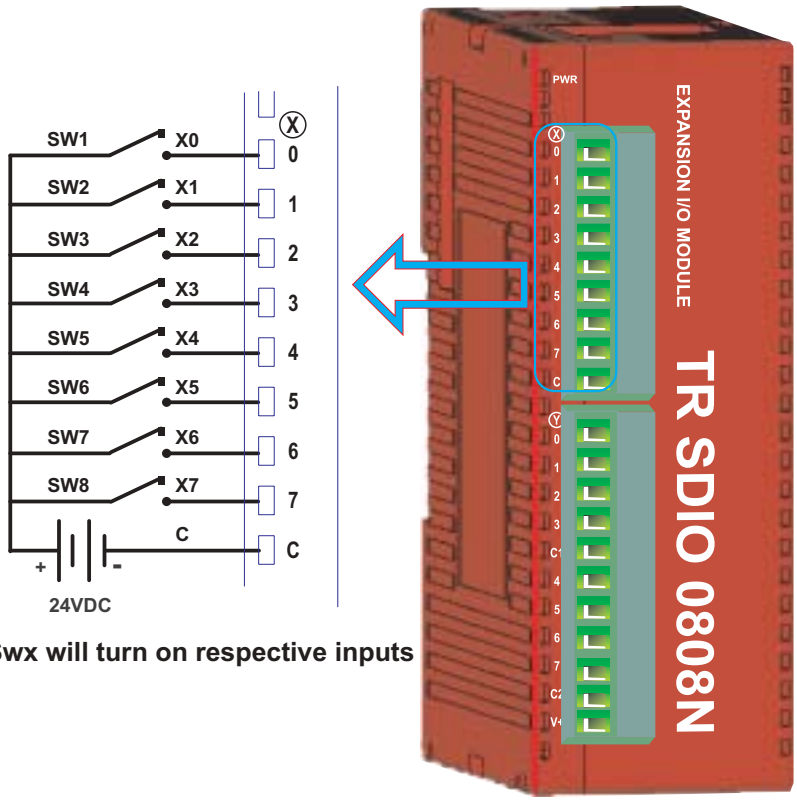
Closing Swx will turn on respective inputs

2. Wiring diagram for output connections:



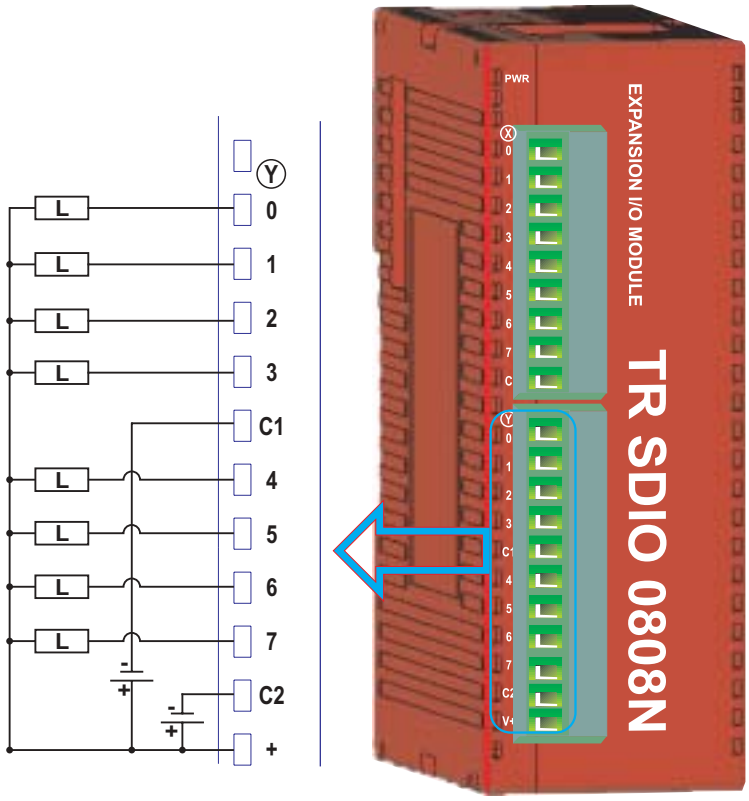
Wiring Diagram for TRSDIO0808N:

1. Wiring diagram for testing digital inputs:



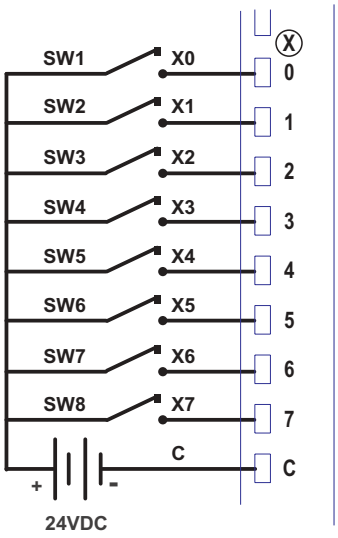
Closing Swx will turn on respective inputs

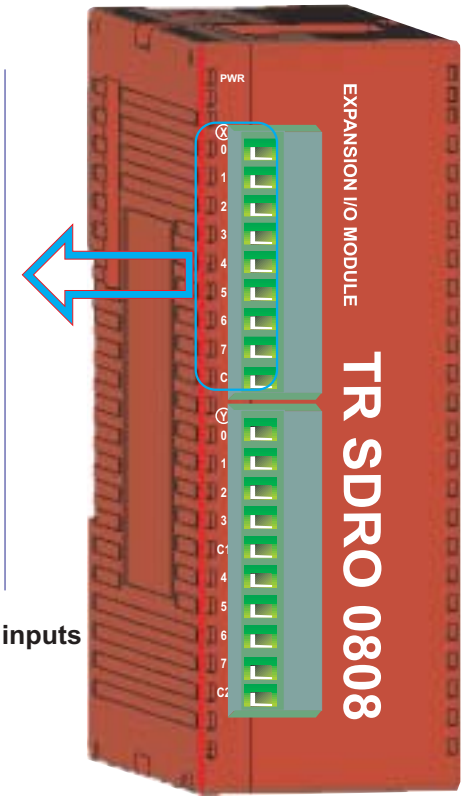
2. Wiring diagram for output connections:



Wiring Diagram for TRSDRO0808:

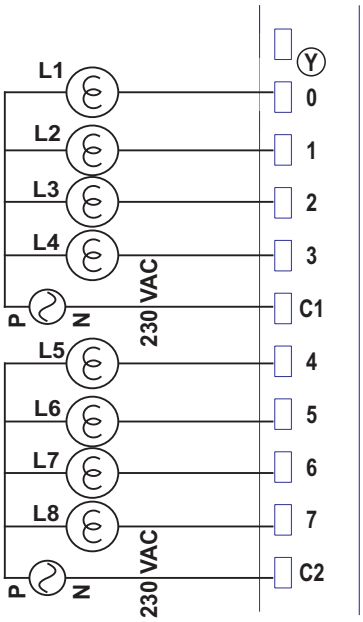
1. Wiring diagram for testing digital inputs:

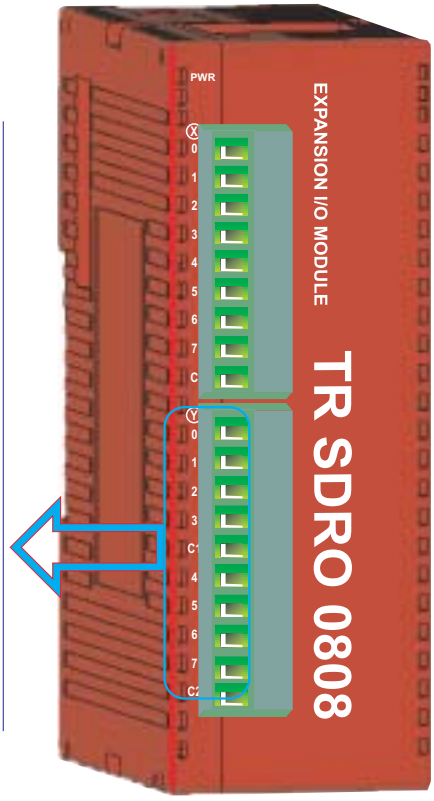




Closing Swx will turn on respective inputs

2. Wiring diagram for output connections:



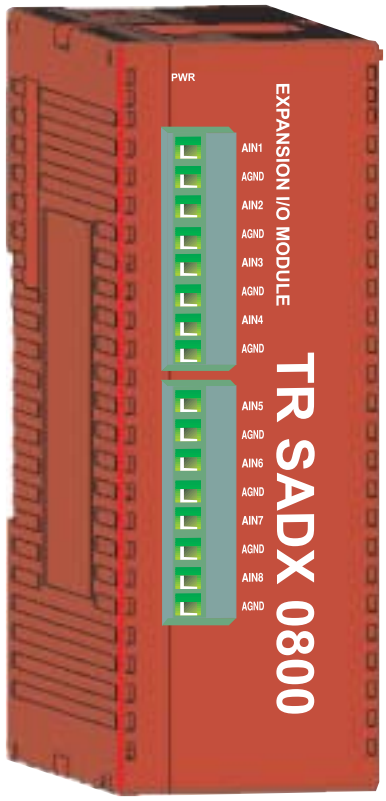


***L1 to L8 are A.C. Load.**

TRSADX0800

Analog Inputs	8 input channels Voltage Input 0 - 10 V Current Input 4- 20 mA
Analog Outputs	0
Isolation	Isolation between analog and digital section. No interchannel isolation.
Connection method	Removable terminals (3.81mm pitch)
Resolution	16 Bit
Accuracy	0.2 % of Full Scale
Nonlinearity	0.04% Max.
Input Impedence	470K ohm (voltage mode) 100 ohm (Current mode)
Temperatur Drift	60 ppm
General	
Operating Temperature	0 to 55 Degree.
Storage Temperature	(-20) to 85 deg.C.
Operating Humidity	10 to 90 % (Non condensing)
Vibration	10Hz to 150Hz ,displace-ment of 0.2 mm (peak) (3 mutually perpendicular axes)
Shock	490.5 m/s2,2 half-sine shocks per axis, on 3 mutually perpendicular axes)
Mechanical Dimension	100mm X 35mm X 70mm
Weight	150 gm.
FTB Transient / Burst)	IEC61000-4-4 [2.2kV (Fast (Power- Direct Injection), 1.2KV (I/O - Capacitive clamp).]
Electrostatic discharge	IEC61000-4-2 Level 3
Electromagnetic field	IEC61000-4-3, 10 V/m AM modulation (80 MHz to 1 GHz)
RF Immunity	IEC61000-4-6, 10 V/m AM modulation (0.15MHz to 80 MHz)
Dumped Oscillatory wave	IEC61000-4-12
Surge Immunity	IEC61000-4-5 Level 2
Radiated emission	EN50081-2

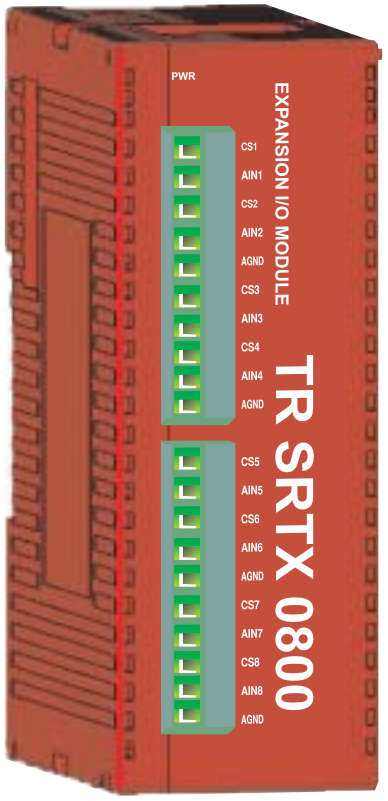
Power Rating (Back Plane)	
Digital Side:	
Voltage Rating	3.75 VDC derived from base model
Current Rating	Upto 80mA
Analog Side:	
Voltage Rating	24 VDC +/-15%
Current Rating	100mA @ 24VDC



TRSRTX0800

Analog Inputs	8 input channels RTD PT100
Analog Outputs	0
Isolation	Isolation between analog and digital section. No interchannel isolation.
Connection method	Removable terminals (3.81mm pitch)
Resolution	16 Bit
Accuracy	0.2 % of Full Scale
Nonlinearity	0.04% Max.
Input Impedence	470K ohm (voltage mode) 100 ohm (Current mode)
Temperatur Drift	60 ppm
General	
Operating Temperature	0 to 55 Degree.
Storage Temperature	(-20) to 85 deg.C.
Operating Humidity	10 to 90 % (Non condensing)
Vibration	10Hz to 150Hz ,displace-ment of 0.2 mm (peak) (3 mutually perpendicular axes)
Shock	490.5 m/s2,2 half-sine shocks per axis, on 3 mutually perpendicular axes)
Mechanical Dimension	100mm X 35mm X 70mm
Weight	150 gm.
FTB Transient / Burst)	IEC61000-4-4 [2.2kV (Fast (Power- Direct Injection), 1.2KV (I/O - Capacitive clamp).]
Electrostatic discharge	IEC61000-4-2 Level 3
Electromagnetic field	IEC61000-4-3, 10 V/m AM modulation (80 MHz to 1 GHz)
RF Immunity	IEC61000-4-6, 10 V/m AM modulation (0.15MHz to 80 MHz)
Dumped Oscillatory wave	IEC61000-4-12
Surge Immunity	IEC61000-4-5 Level 2
Radiated emission	EN50081-2

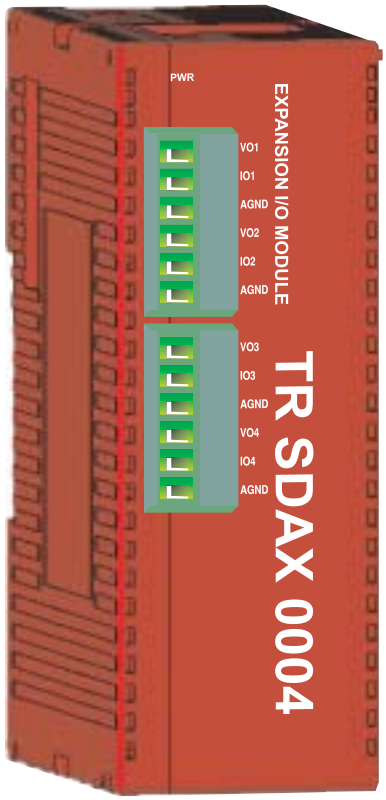
Power Rating (Back Plane)	
Digital Side:	
Voltage Rating	3.75 VDC derived from base model
Current Rating	Upto 80mA
Analog Side:	
Voltage Rating	24 VDC +/-15%
Current Rating	100mA @ 24VDC



TRSDAX0004

Analog Inputs	0
Analog Outputs	4 Output channels Voltage 0 - 10 V (Min Load 1000 ohm) Current 4 - 20 mA(Max load 500 ohm)
Isolation	Isolation between analog and digital section. No interchannel isolation.
Connection method	Removable terminals (3.81mm pitch)
Resolution	16 Bit
Accuracy	0.2 % of Full Scale
Nonlinearity	0.04% Max.
General	
Operating Temperature	0 to 55 Degree.
Storage Temperature	(-20) to 85 deg.C.
Operating Humidity	10 to 90 % (Non condensing)
Vibration	10Hz to 150Hz ,displacement of 0.2 mm (peak) (3 mutually perpendicular axes)
Shock	490.5 m/s2,2 half-sine shocks per axis, on 3 mutually perpendicular axes)
Mechanical Dimension	100mm X 35mm X 70mm
Weight	150 gm.
FTB (Fast Transient / Burst)	IEC61000-4-4 [2.2kV (Power- Direct Injection), 1.2KV (I/O - Capacitive clamp).]
Electrostatic discharge	IEC61000-4-2 Level 3
Electromagnetic field	IEC61000-4-3, 10 V/m AM modulation (80 MHz to 1 GHz)
RF Immunity	IEC61000-4-6, 10 V/m AM modulation (0.15MHz to 80 MHz)
Dumped Oscillatory wave	IEC61000-4-12
Surge Immunity	IEC61000-4-5 Level 2
Radiated emission	EN50081-2

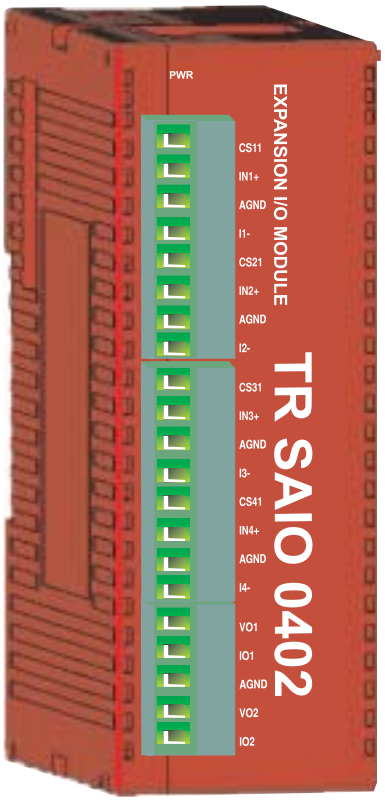
Power Rating (Back Plane)	
Digital Side:	
Voltage Rating	3.75 VDC derived from base model
Current Rating	Upto 80mA
Analog Side:	
Voltage Rating	24 VDC +/-15%
Current Rating	150mA @ 24VDC



TRSAIO0402

Analog Inputs	4 Universal Input Channels Voltage Input 0 - 10 V Current Input 0-20mA, 4-20mA RTD PT100 (alpha1, alpha2) Thermocouple(TYPE B,R,S,E,J,K,N,T.) mV 0-100mV, 0-50 mV
Analog Outputs	2 Output channels Voltage 0 - 10 V (Min Load 1000 ohm) Current 4 - 20 mA (Max load 500 ohm)
Isolation	Isolation between analog and digital section. No interchannel isolation.
Connection method	Removable terminals (3.81mm pitch)
Resolution	16 Bit
Accuracy	0.2 % of Full Scale
Nonlinearity	0.04% Max.
Input Impedence	1Mohm (Voltage/mV/TC/RTD mode) typically 30 ohm (Current mode)
Excitation Current for RTD	0.5 mA
General	
Operating Temperature	0 to 55 Degree.
Storage Temperature	(-20) to 85 deg.C.
Operating Humidity	10 to 90 % (Non condensing)
Vibration	10Hz to 150Hz ,displacement of 0.2 mm (peak) (3 mutually perpendicular axes)
Shock	490.5 m/s2,2 half-sine shocks per axis, on 3 mutually perpendicular axes)
Mechanical Dimension	100mm X 35mm X 70mm
Weight	150 gm.
FTB (Fast Transient / Burst)	IEC61000-4-4 [2.2kV (Power- Direct Injection), 1.2KV (I/O - Capacitive clamp).]
Electrostatic discharge	IEC61000-4-2 Level 3
Electromagnetic field	IEC61000-4-3, 10 V/m AM modulation (80 MHz to 1 GHz)
RF Immunity	IEC61000-4-6, 10 V/m AM modulation (0.15MHz to 80 MHz)
Dumped Oscillatory wave	IEC61000-4-12
Surge Immunity	IEC61000-4-5 Level 2
Radiated emission	EN50081-2

Power Rating (Back Plane)	
Digital Side:	
Voltage Rating	3.75 VDC derived from base model
Current Rating	Upto 80mA
Analog Side:	
Voltage Rating	24 VDC +/-15%
Current Rating	150mA @ 24VDC



HARDWARE

In this chapter. . . .

- Unpacking the unit
- Managing Electrostatic Discharge
- CE Compliance
- Environmental rating
- Environmental Consideration
- Safety Precautions
- Installation Instructions
- Wiring Diagram
- Communication Port

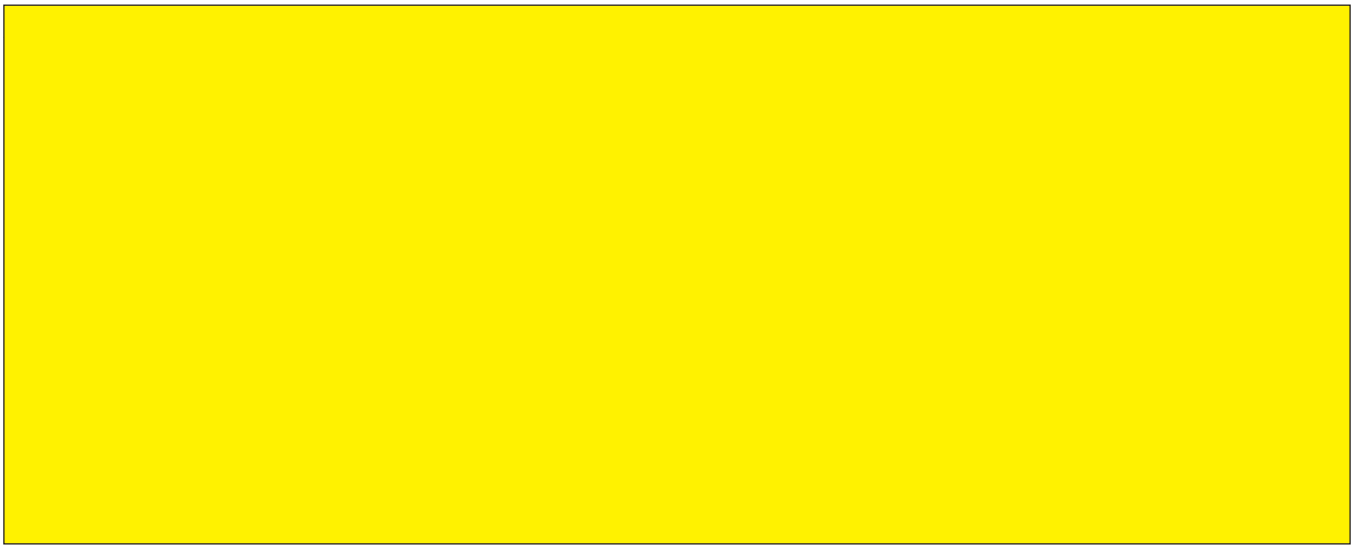
2.1 Unpacking The Unit

Carefully unpack the TR unit. Please read all the instructions and cautions that appear on the shipping container. Check that the container includes the Mounting DIN rail slider, locking connector, and a silica gel bag. The silica gel bag is enclosed to absorb the moisture in the packing. Toshiba I.P.S.C. will not accept responsibility for shortages against the packing list unless notified within 30 days. The unit and its accessories were inspected and tested by Toshiba I.P.S.C.before shipment. All equipment should be in good working order. Examine the product carefully and notify the carrier immediately if any shipping damage is evident. You are responsible for claim negotiations with the carrier. Save the shipping container and packing material in case the equipment needs to be stored, returned to Toshiba I.P.S.C., or transported for any reason.

2.2 Managing Electrostatic Discharge

It is best NOT to remove the any enclosure of the TR unit. When the any part of the enclosure is removed, the circuitry inside is exposed to possible damage by electrostatic discharge during handling. Minimize the possibility of electrostatic discharge by:

- Discharging personal static by grounding yourself prior to handling the TR unit.
- Handling the TR unit at a static-free grounded workstation.
- Connecting the frame ground ( ) connector of the TR to a clean earth ground.
- Placing the TR in an antistatic bag during transport.



2.5 Environmental Consideration

Toshiba products are designed to operate at temperature range from 0-50^{0} C. It is intended primarily for indoor installations and may not be suitable for certain outdoor applications. Avoid installing the Toshiba products in environments with severe mechanical vibration or shocks. Do not install the TR in enclosures with rapid temperature variations or high humidity. Either will cause condensation of water inside the device and eventual damage to the TR.

2.6 Safety Precaution

General Information:

1. TRs has been designed and manufactured for use in an industrial environment. However, the TR is not intended to be used for systems which may endanger human life. Consult factory if you intend to use the TR for a special application, such as transportation machines, medical apparatus, aviation and space systems, nuclear controls, submarine systems, etc.

2. The TR has been manufactured under strict quality control. However, to keep safety of overall automated system, fail-safe systems should be considered outside the TR.

3. In installation, wiring, operation and maintenance of the TRs, it is assumed that the users have general knowledge of industrial electric control systems. If this product is handled or operated improperly, electrical shock, fire or damage to this product could result.

4. This manual has been written for users who are familiar with Programmable Controllers and industrial control equipment. Contact factory if you have any questions about this manual.

Hazard Classifications:

In this manual, the following two hazard classifications are used to explain the safety precautions.

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Even a precaution is classified as CAUTION, it may cause serious results depending on the situation. Observe all the safety precautions described on this manual.

2.7 Installation Instruction

CAUTION

1. Excess temperature, humidity, vibration, shocks, or dusty and corrosive gas environment can cause electrical shock, fire or malfunction. Install and use the TR and related equipment in the environment described in this manual.

2. Improper installation directions or insufficient installation can cause fire or the units to drop. Install the TR and related equipment in accordance with the instructions described in this manual.

3. Turn off power before installing or removing any units, modules, racks or terminal blocks. Failure to do so can cause electrical shock or damage to the TR and related equipment.

4. Entering wire scraps or other foreign debris into to the TR and related equipment can cause fire or malfunction. Pay attention to prevent entering them into the TR and related equipment during installation and wiring.

5. Turn off power immediately if the TR or related equipment is emitting smoke or odor. Operation under such situation can cause fire or electrical shock. Also unauthorized repairing will cause fire or serious accidents. Do not attempt to repair. Contact factory for repairing.

Wiring:

CAUTION

1. Turn off power before wiring to minimize the risk of electrical shock.

2. Exposed conductive parts of wire can cause electrical shock. Use crimp-style terminals with insulating sheath or insulating tape to cover the conductive parts. Also close the terminal covers securely on the terminal blocks when wiring has been completed.

3. Operation without grounding may cause electrical shock or malfunction. Connect the ground terminal on the TRs to the system ground.

4. Applying excess power voltage to the TR can cause explosion or fire. Apply power of the specified ratings described in the manual.

5. Improper wiring can cause fire, electrical shock or malfunction. Observe local regulations on wiring and grounding.

2.8 Installation Instructions

The TRs should be mounted on a din rail plate. A din rail sliders and locking connectors are provided with each TR unit for proper installation.

Environmental Considerations:
Make sure that the unit is installed correctly and that the operating limits are followed (see Specifications for TR). Do not operate the TR in areas subject to explosion hazards due to flammable gases, vapors or dusts. A TR should not be installed where fast temperature variations are present. Highly humid areas are also to be avoided. High humidity causes condensation of water in the unit.

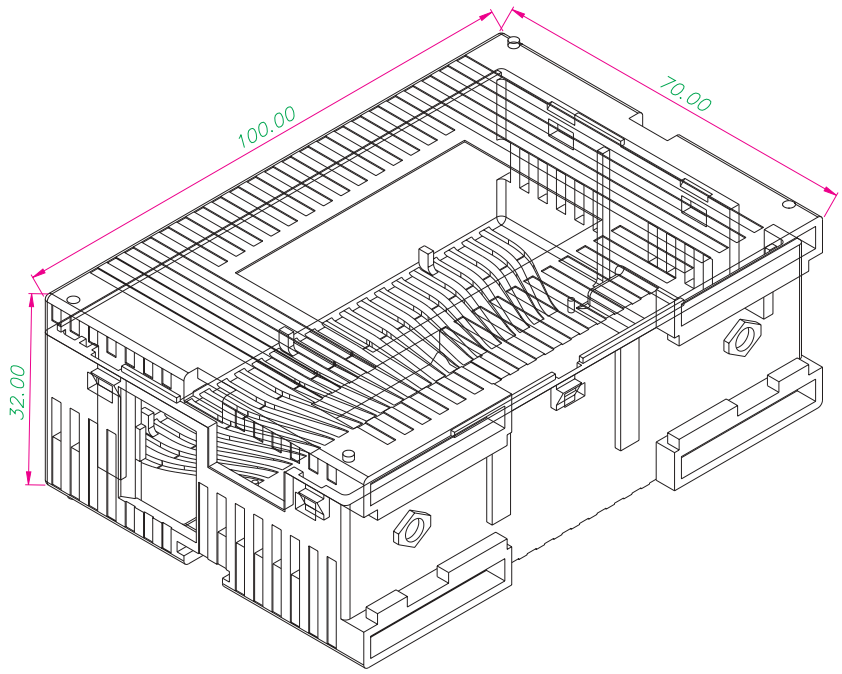
Location Considerations:
Care should be taken when locating equipment behind the TR to ensure that AC power wiring, PLC output modules, contactors, starters, relays and any other source of electrical interference are located away from the TR. Particular care should be taken to locate variable speed drives and switching power supplies away from the TR.

Panel Mounting
This section presents the dimensional sketches and din rail sliding for TR models.
(All dimensions are in mm and drawing are not to scale.)

2.8.1 Panel Mounting

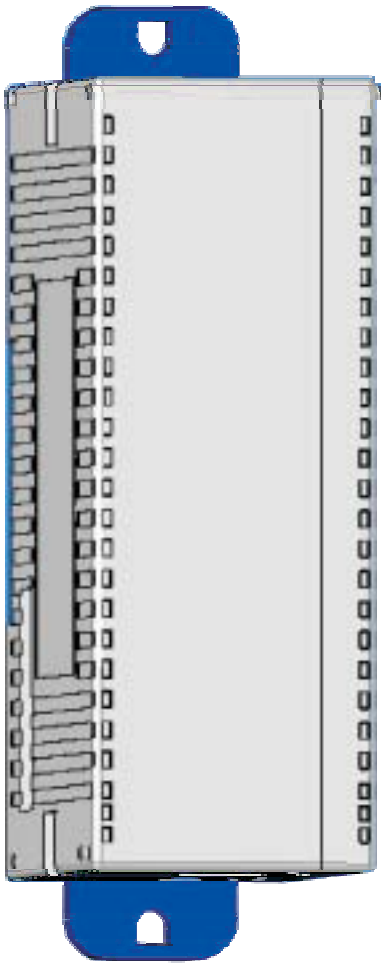
TR units are shipped with a separate DIN rail slider & locking connector attached to the unit. User can use the unit with or without DIN rail slider.

Dimensional Details:

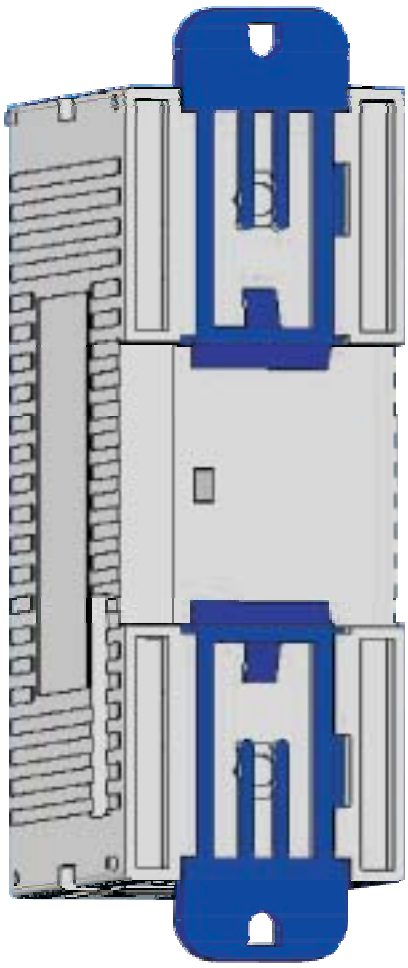


TR unit with DIN rail slider

Front View



Rare View



Steps to mount the unit on DIN rail plate

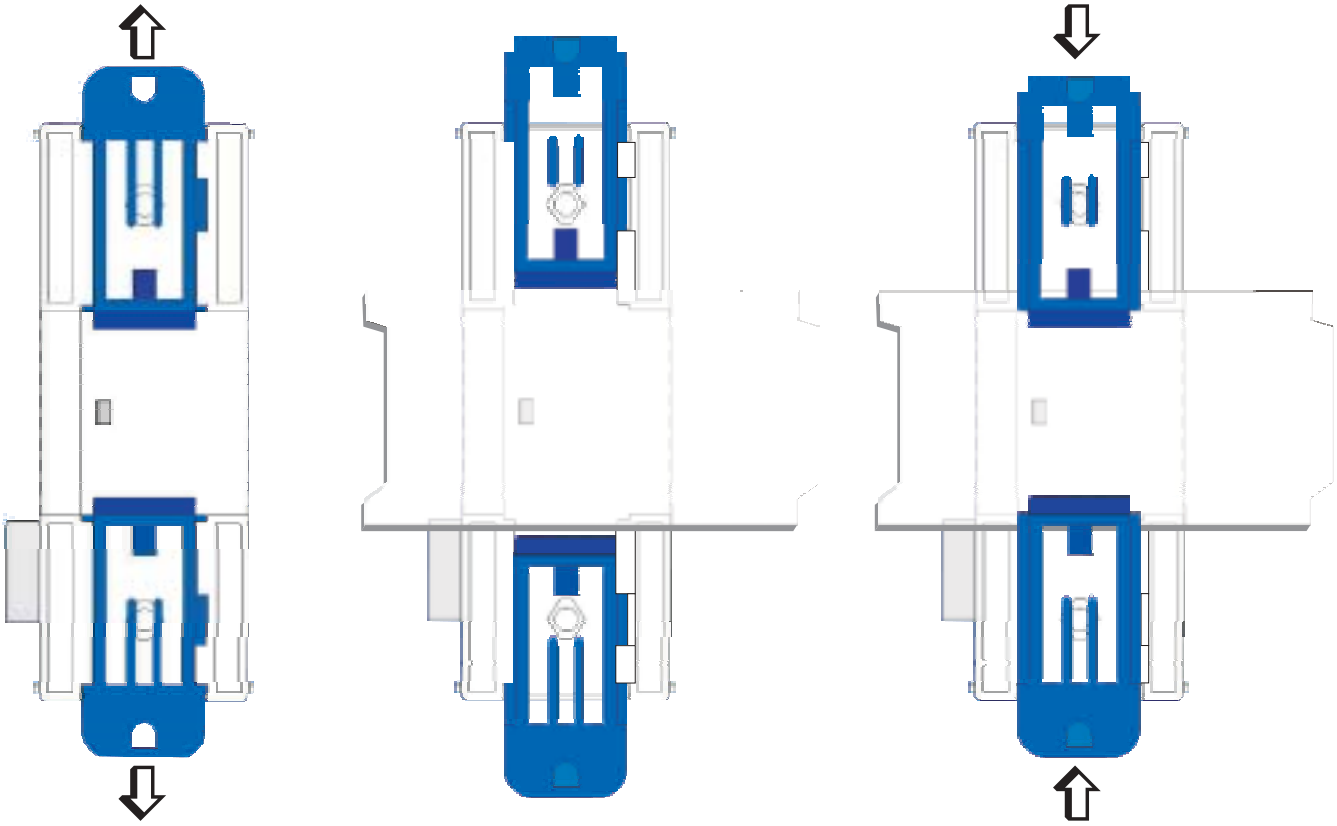


FIG-1 FIG-2 FIG-3

FIG-1 Pull up the sliders provided with the TR towards outward direction.

FIG-2 Rest the unit on the DIN rail plate

FIG-3 Pull down the slider again so that unit can fix up with the DIN rai plate

Steps to lock the expansion TR with the base TR

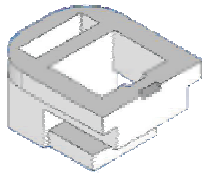


FIG-1

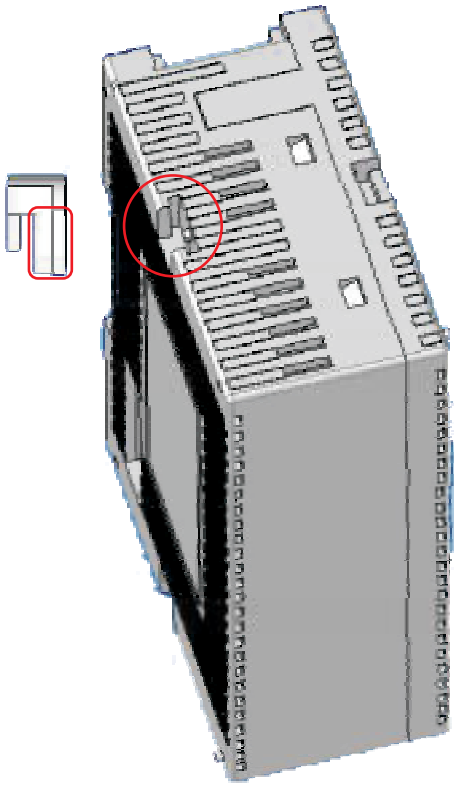


FIG-2

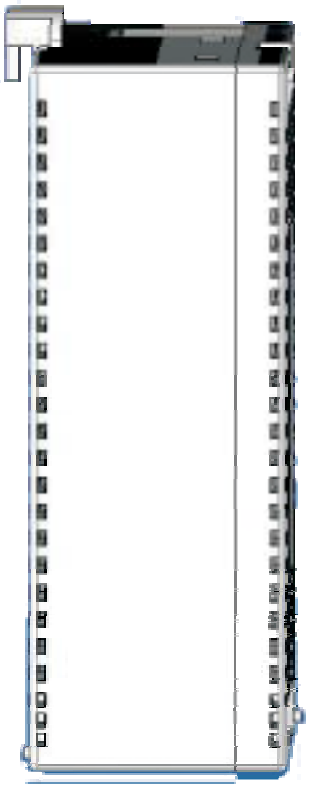


FIG-3

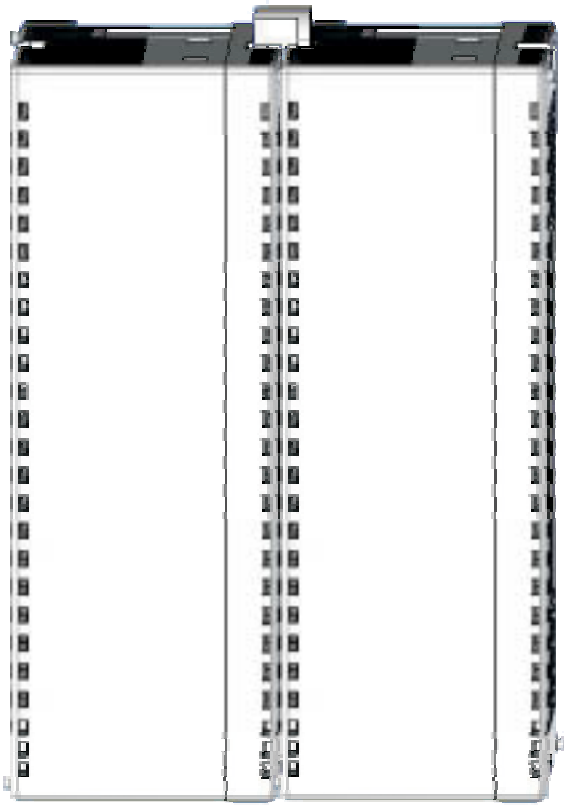


FIG-4

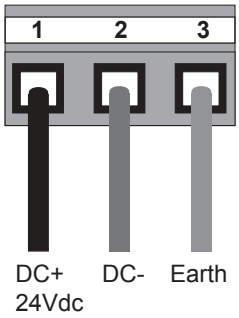
FIG-1	Lock connector provided with TR unit
FIG-2	Two slots to grip the locking connector are provided on the case highlighted by RED circle. Insert a big leg of locking connector highlighted by RED rectangle.
FIG-3	Single TR unit with locking connector
FIG-4	Locking connector helps the two units (TR base &/or TR expansion) to hold each-other properly on the DIN rail plate along with DIN rail slider.

2.9 Wiring Diagram

If wiring is to be exposed to lightening or surges, use appropriate surge suppression devices. Keep AC, high energy and rapidly switching DC wiring separate from signal wires.

Connecting high voltages or AC power mains to the DC input will make unit unusable and may create an electrical shock hazard to personnel. Such a failure or shock could result in serious personal injury, loss of life and/or equipment damage. DC voltage sources should provide proper isolation from main AC power and similar hazards.

Pin description of the power connector for base (TRSPUX10A and TRSPUX10E) models is as follows:



2.10 Communication Ports

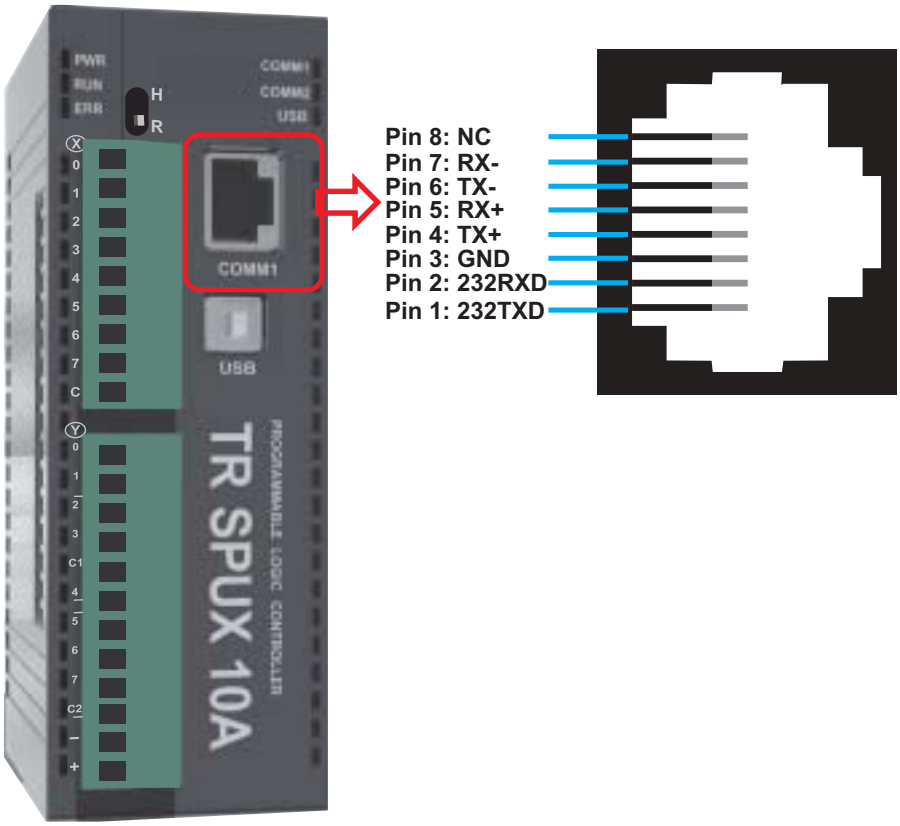
TR communication ports support three types of serial communication.

They have two communication Ports in which COM1 is multi-signal port. Multi-Signal means that COM1 port has RS232, RS422, and RS485 signal levels.

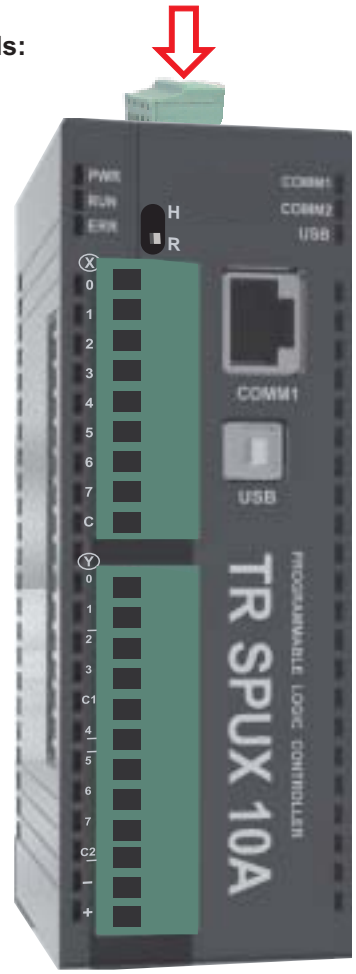
A TR can simultaneously communicate on both serial ports. The TR can be programmed from a PC on either port. Both ports can also be used with a serial printer.

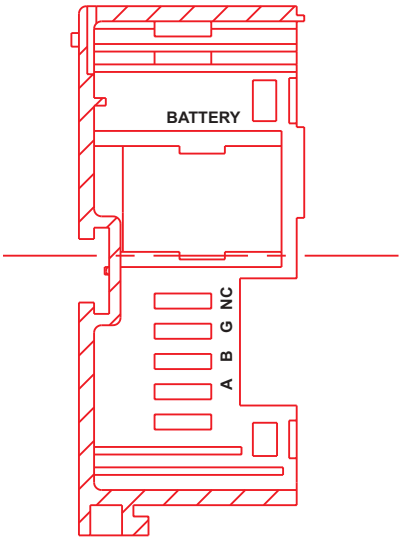
Different cables are required to connect the TR to a specific PLC. Cable details for any particular device are given in the Operation Manual for that device. The pin description of the communication ports for TR model is as given below:

1. COM1 Port Details:



2. COM2 Port Details:





USB Device:

1. USB Device, compliant with USB 2.0 specification, self powered device.
2. Connector used: Standard USB Type B Female connector.

Ethernet:

1. Fully compliant with IEEE 802.3 / 802.3u standards.
2. 10/100 Mbps support.
3. Connector used: Standard shielded RJ-45 female jack with in-built speed and link activity indication LEDs.

BEFORE YOU BEGIN

In this chapter. . . .

- Connecting TR to a computer
- Starting TR PGM Configuration Software
- Launching Ladder Text Editor

3.1 Connecting the TR unit to your computer

Before you start your first project, the unit should be connected to the computer so that the project can be down-loaded after creating it.

To connect your unit to the computer

1) Connect a +24VDC power supply to the unit.
2) Connect the programming cable to the computer and TR base model.
   Connect IBM cable to the communication port of the unit.
   Download Firmware i.e. driver for the PLC. The unit cannot communicate with PLC till the required driver is downloaded.
3) Apply power to the unit.

To connect your PLC to unit

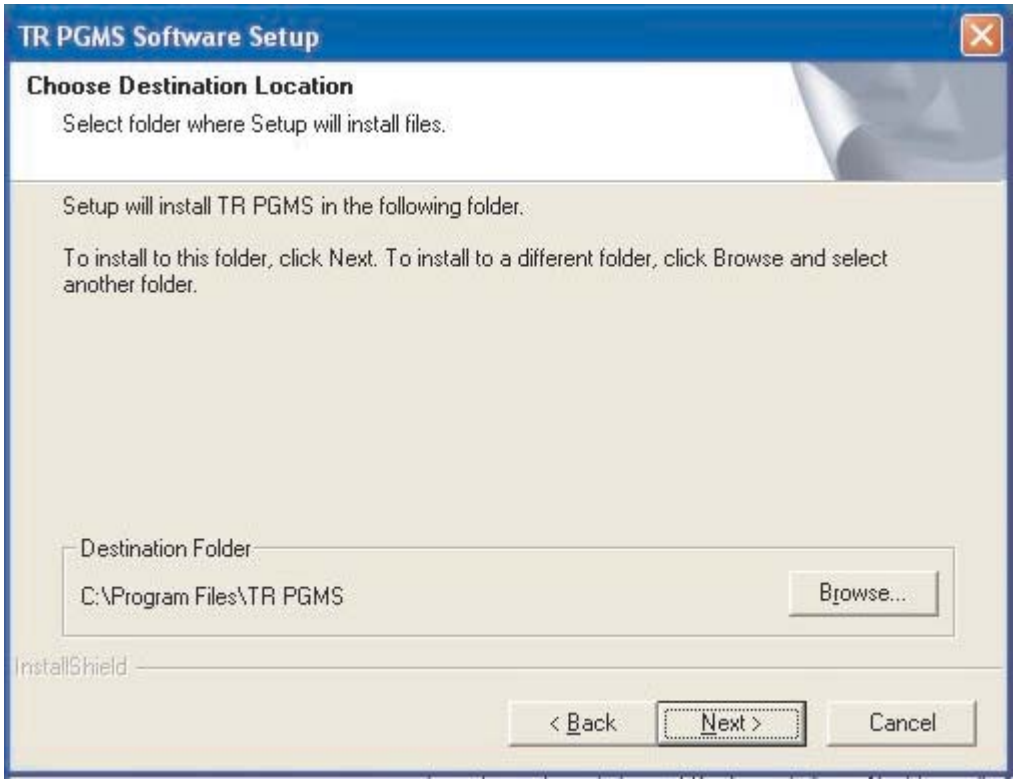
A unit can communicate with any PLC without any change in the TR hardware. To communicate with a PLC, the unit needs:

1) Proper Communication Driver for the PLC
   Each PLC has a defined protocol for communicating with any device. The communication driver is downloaded into the unit along with the firmware. The communications driver varies from PLC to PLC. This driver enables the unit to talk to a specific PLC.
2) TR - PLC communication cable
   A proper TR - PLC cable is required for error free communication with any PLC.

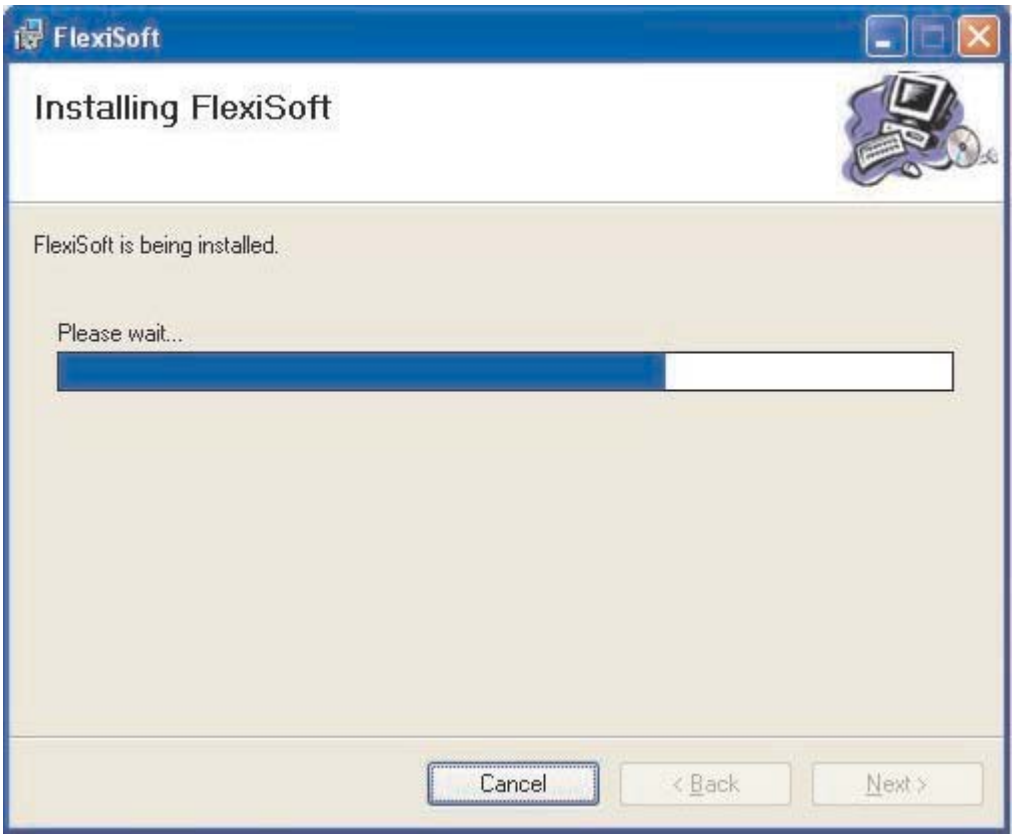
3.2 Installing TR PGM configuration software:

To install TR PGM configuration Software:

1. Open Microsoft® Windows.
2. Select Run and Pop up window appears. Type the path for installing the Setup.
   This will install TR PGM Configuration Setup Software.
3. When you click on OK, Welcome window appears on the screen. Click on Next.
4. Select the destination folder where setup will install the files.



5. Click on “NEXT”, installation starts. A dialog box indicating the status of progress of installation will display.



6. A screen is displayed to inform you when installation is completed.

This procedure installs TR PGM Software in start menu (in selected folder).

3.3 Steps for starting TR PGM Software

1. In Windows click the Start button.
2. Select Programs.
3. Select “TR PGM”.
4. Select TR PGM setup exe.
5. Select New Application either from Tool station or from File Menu.
6. Select the model and product type that you would like to set by clicking on picture of the product in the list.
7. Define the Unit Settings.
8. Next step is to define Tag Database and then define the screens according to your application.

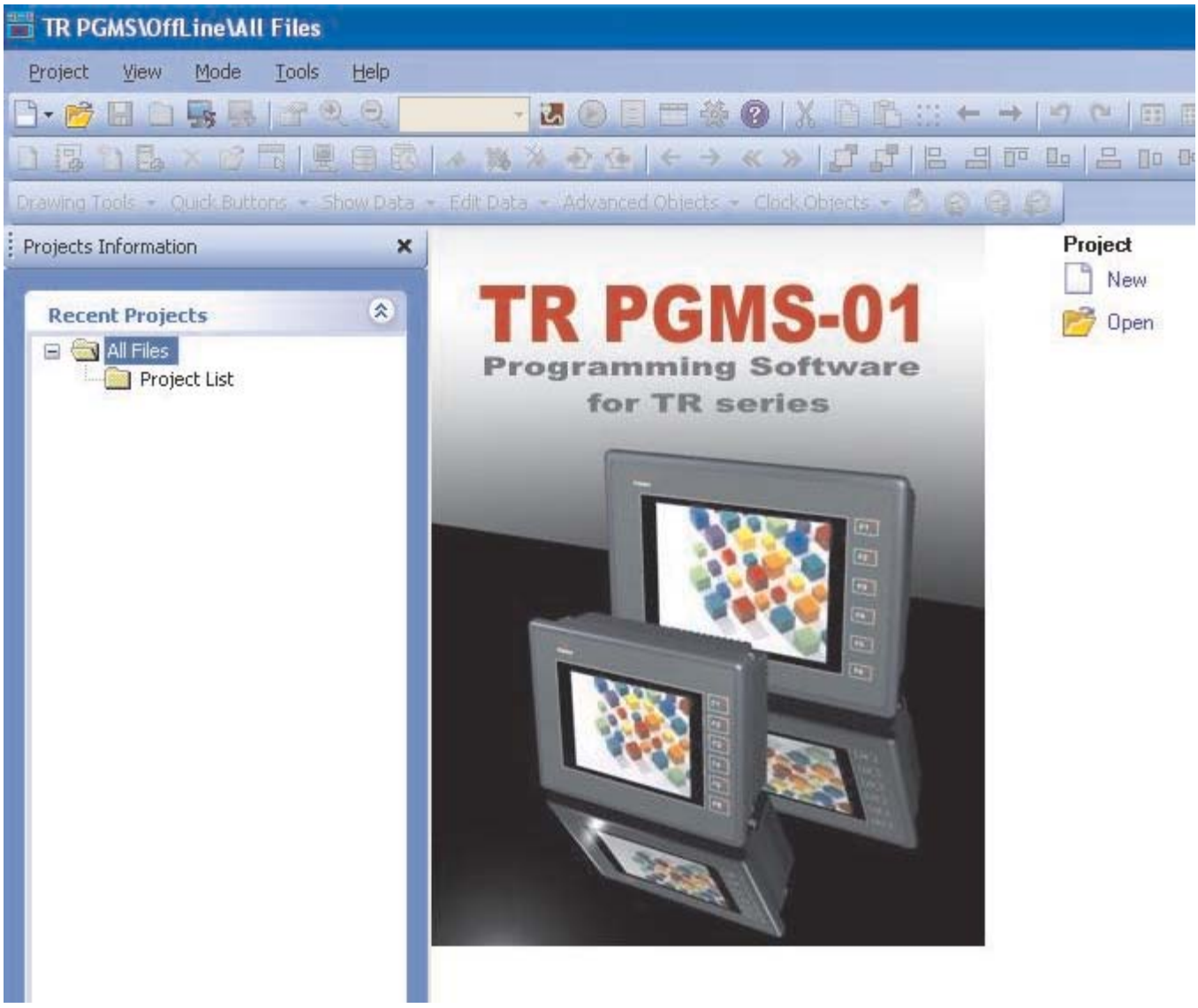
3.4 Uninstalling TR PGM Software

1. In Windows click the Start button.
2. Select Programs.
3. Select TR PGM.
4. Select Uninstall TR PGM.

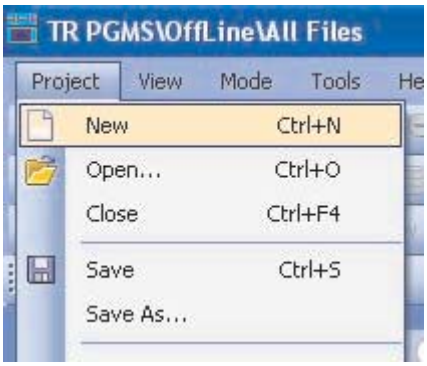
Following screen will display. The screen will ask you for the confirmation for uninstalling TR PGM configuration software.

3.5 Procedure to launch ladder in TR PGM

Launch TR PGM setup software on your PC. Below shown welcome screen will display.

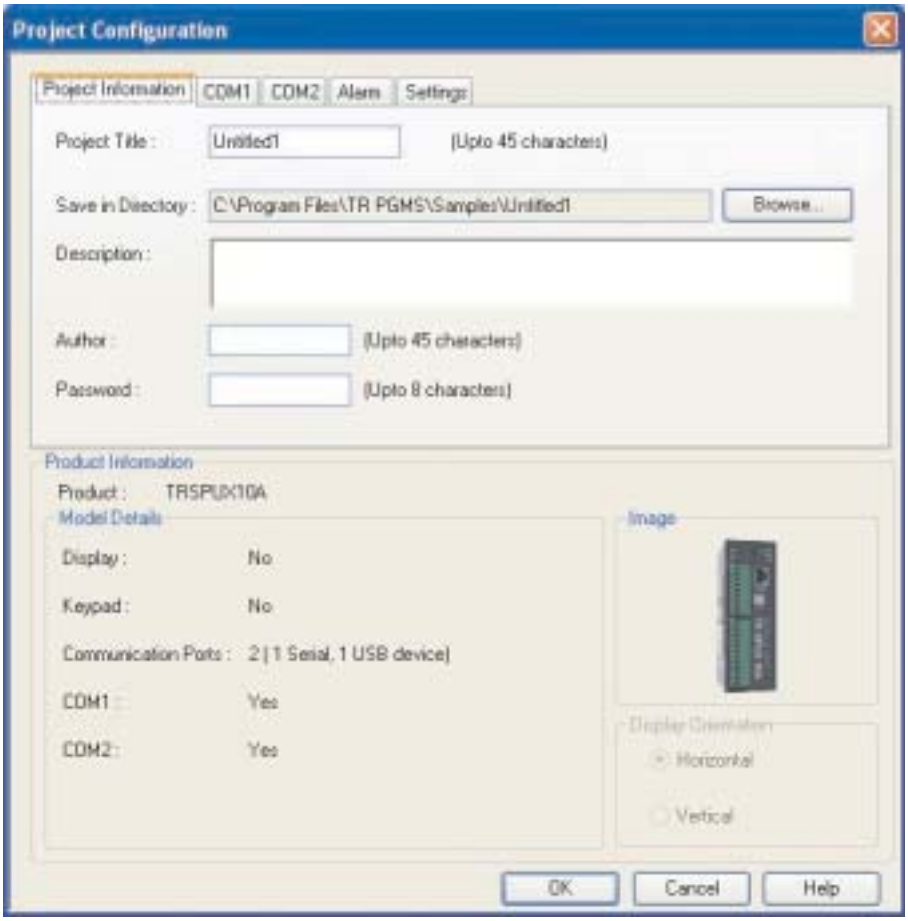


To launch a ladder application either choose Project -> New option or click on New application icon as shown below:

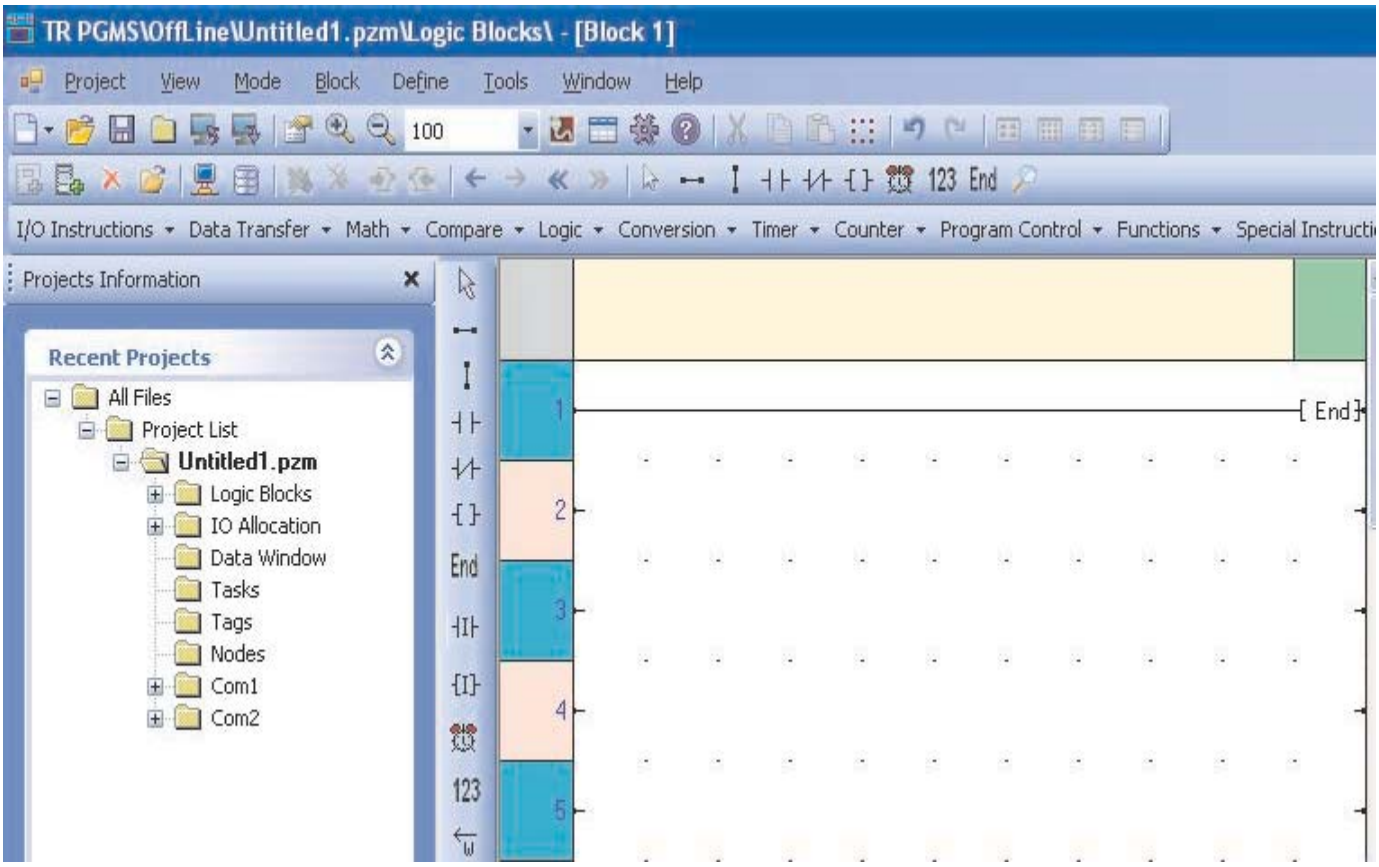


Following screen will appear:

Click on “OK” button. In the next appearing window, write Project Title and click on “OK” button as shown below:



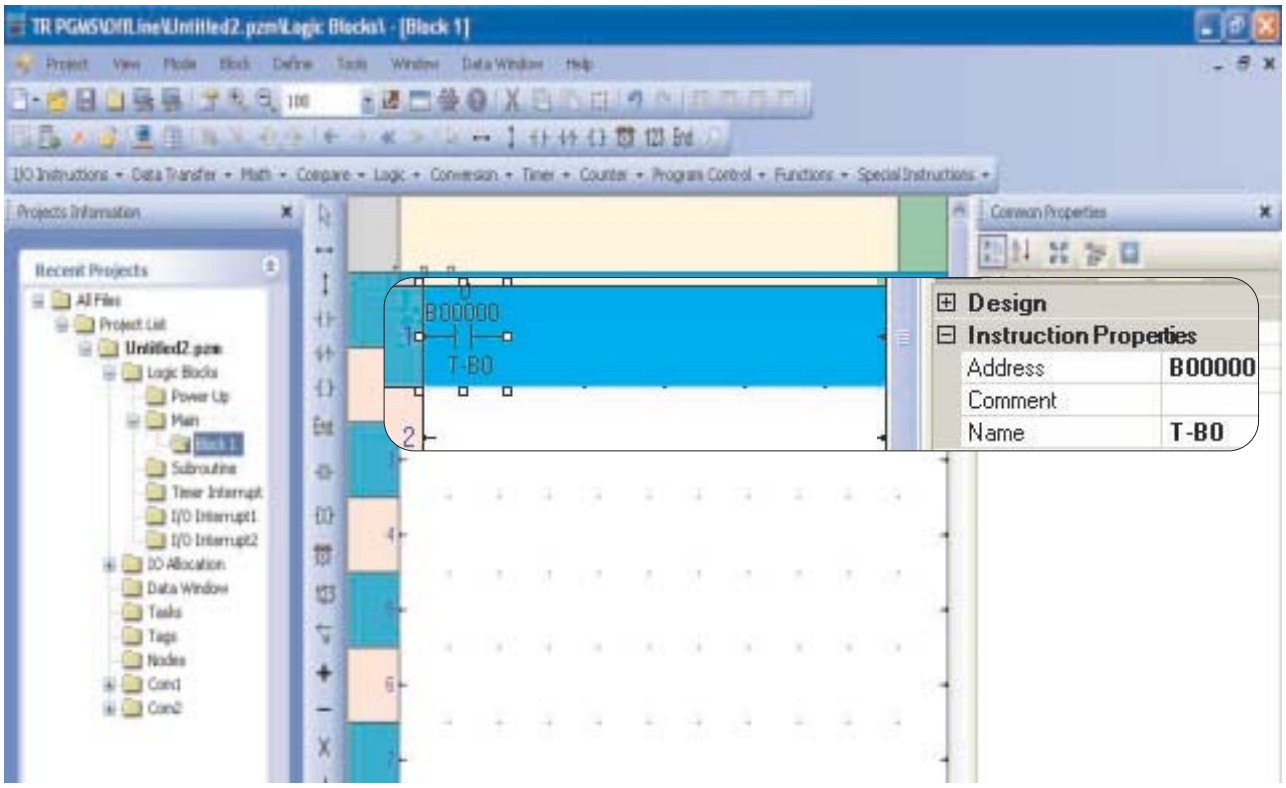
A ladder Text Editor appears as shown below:

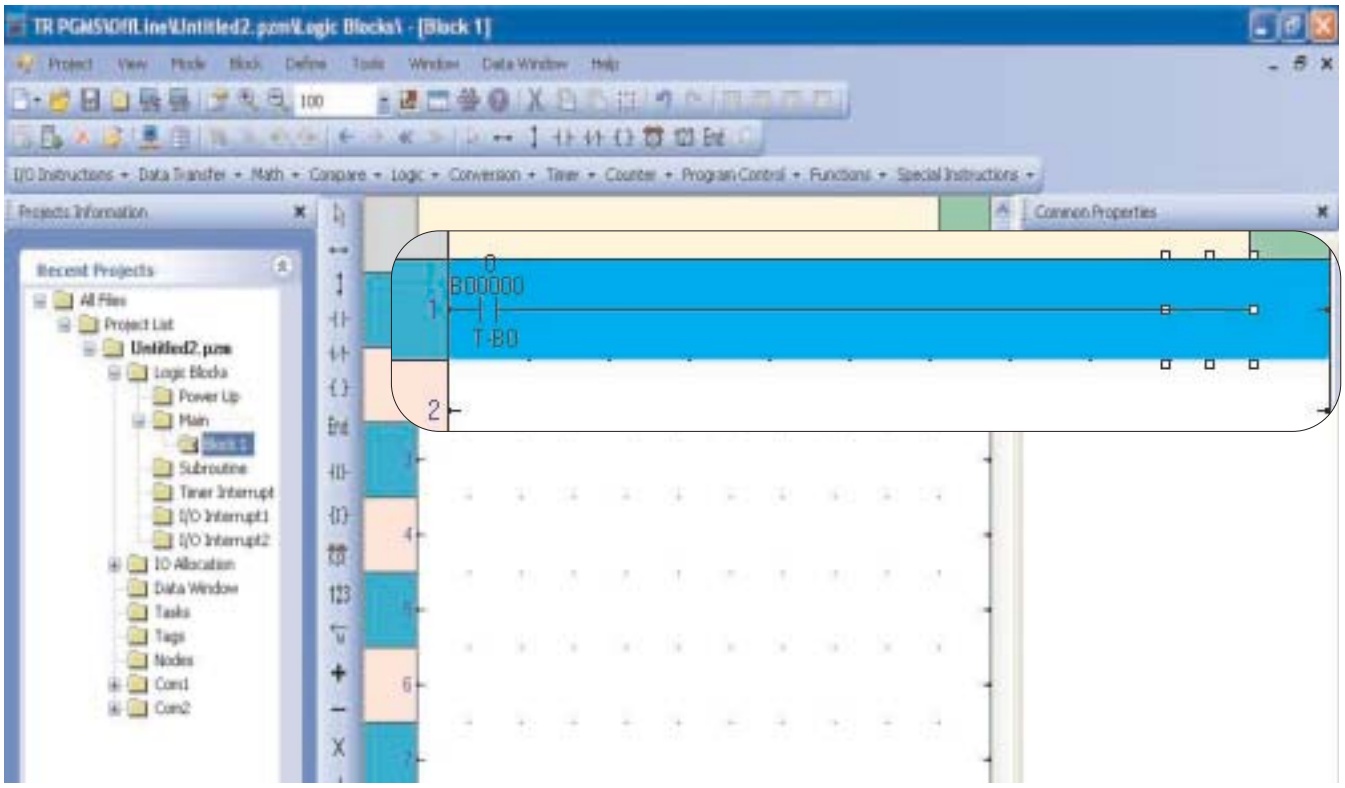


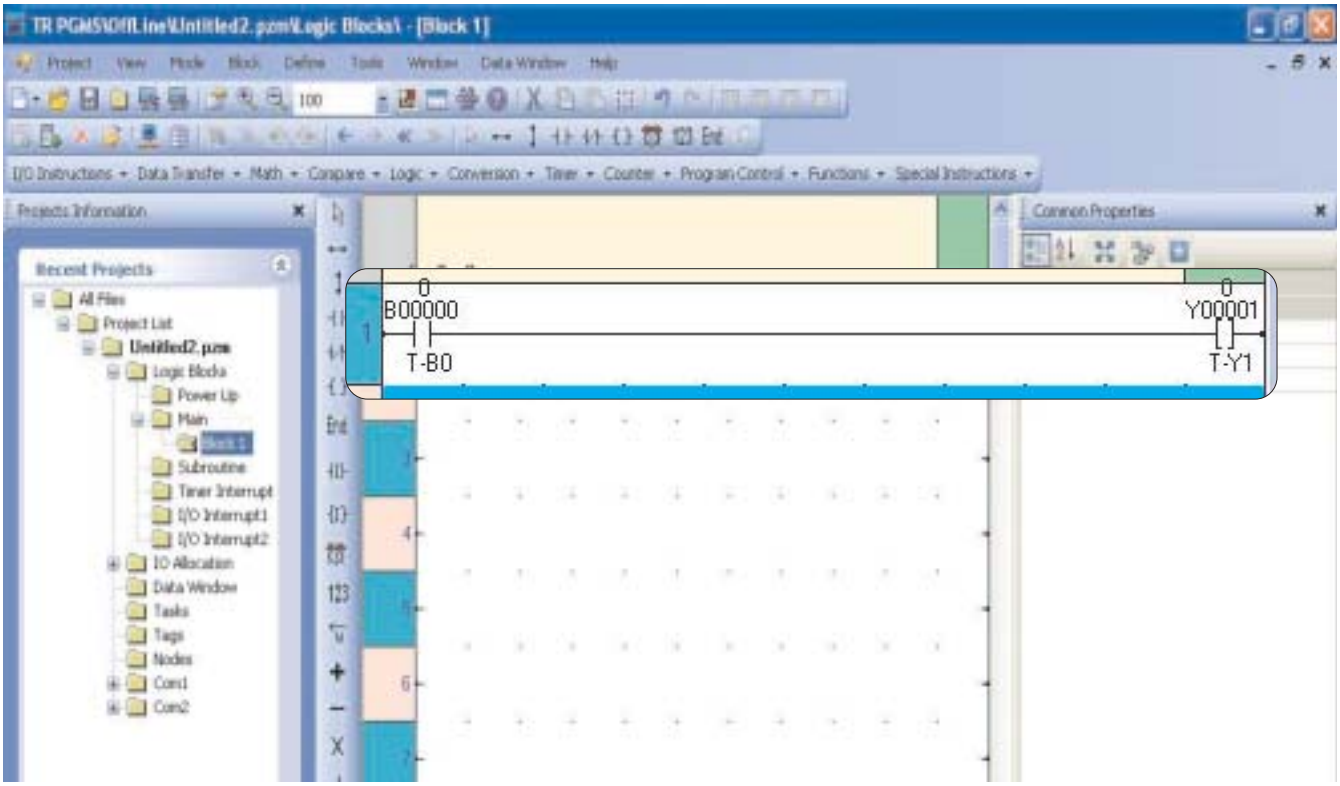
Now here you can create your ladder

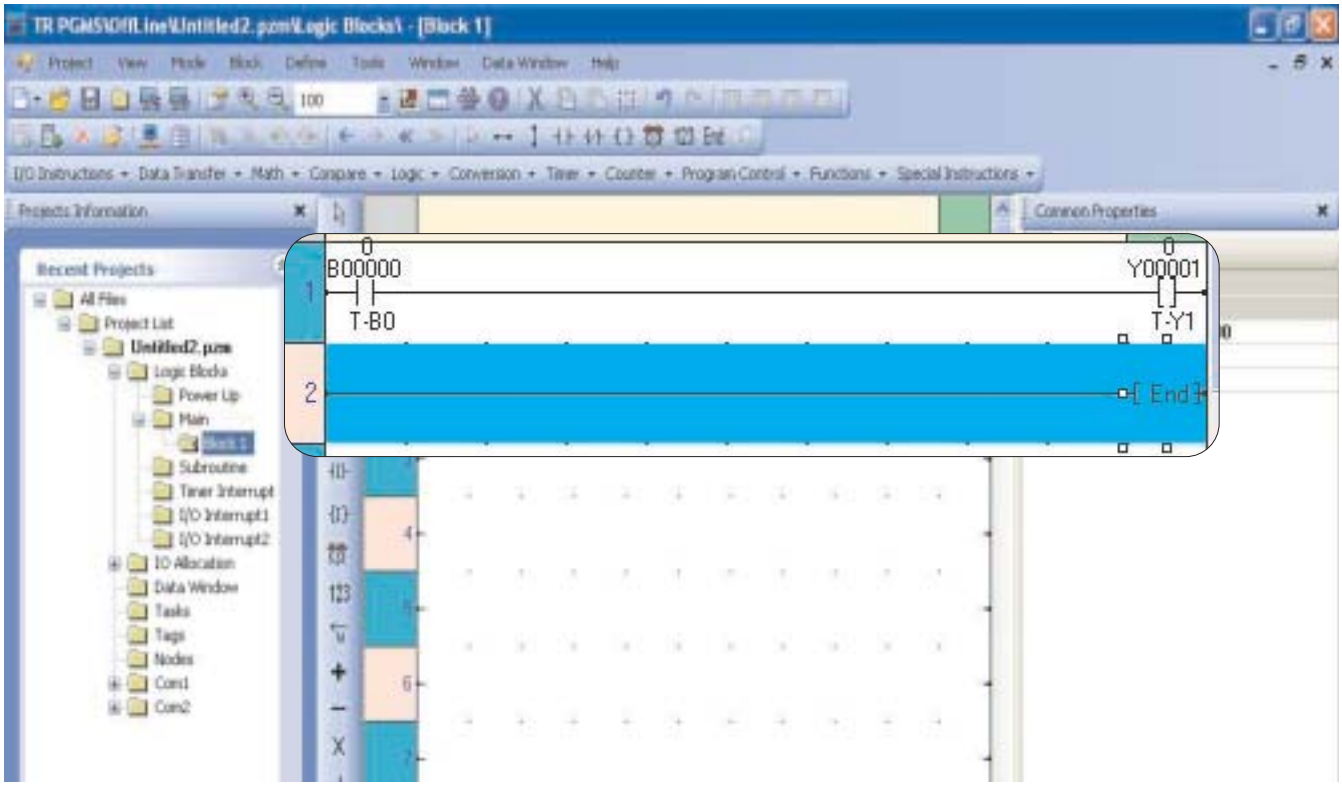
3.6 Creating sample ladder

After launching Ladder Text Editor, you can create a ladder here. Steps are shown below:
Step-1:

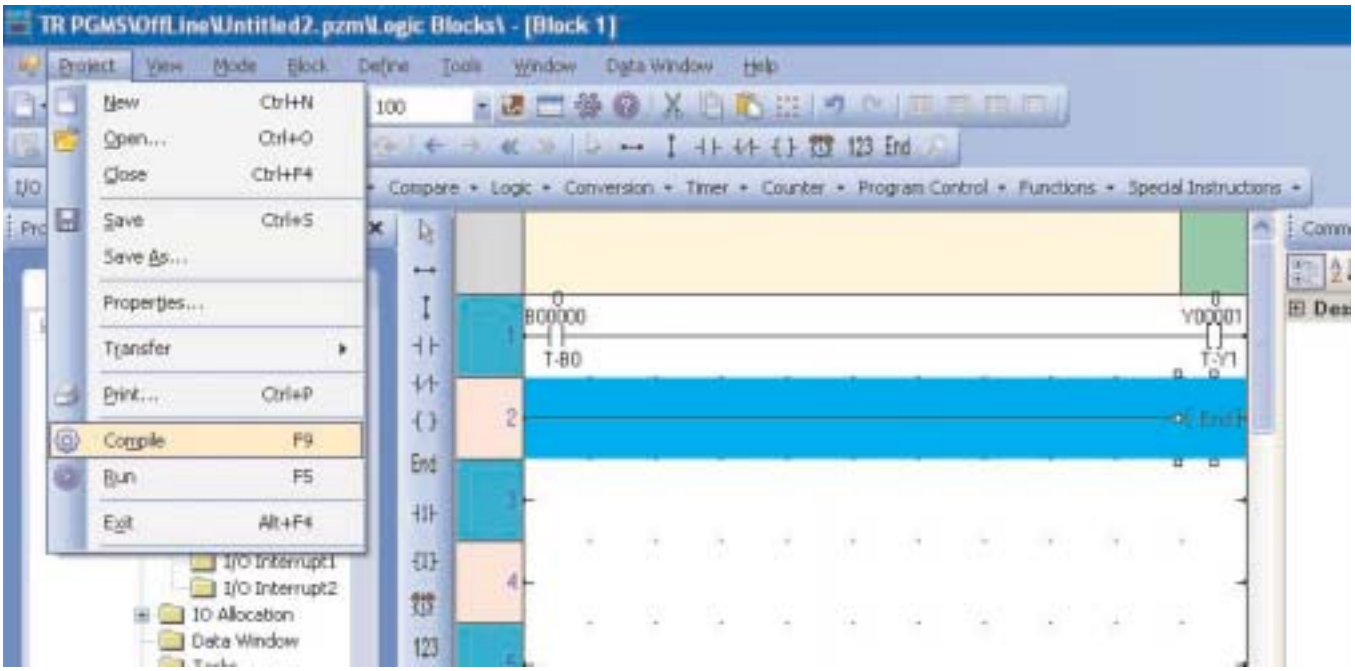




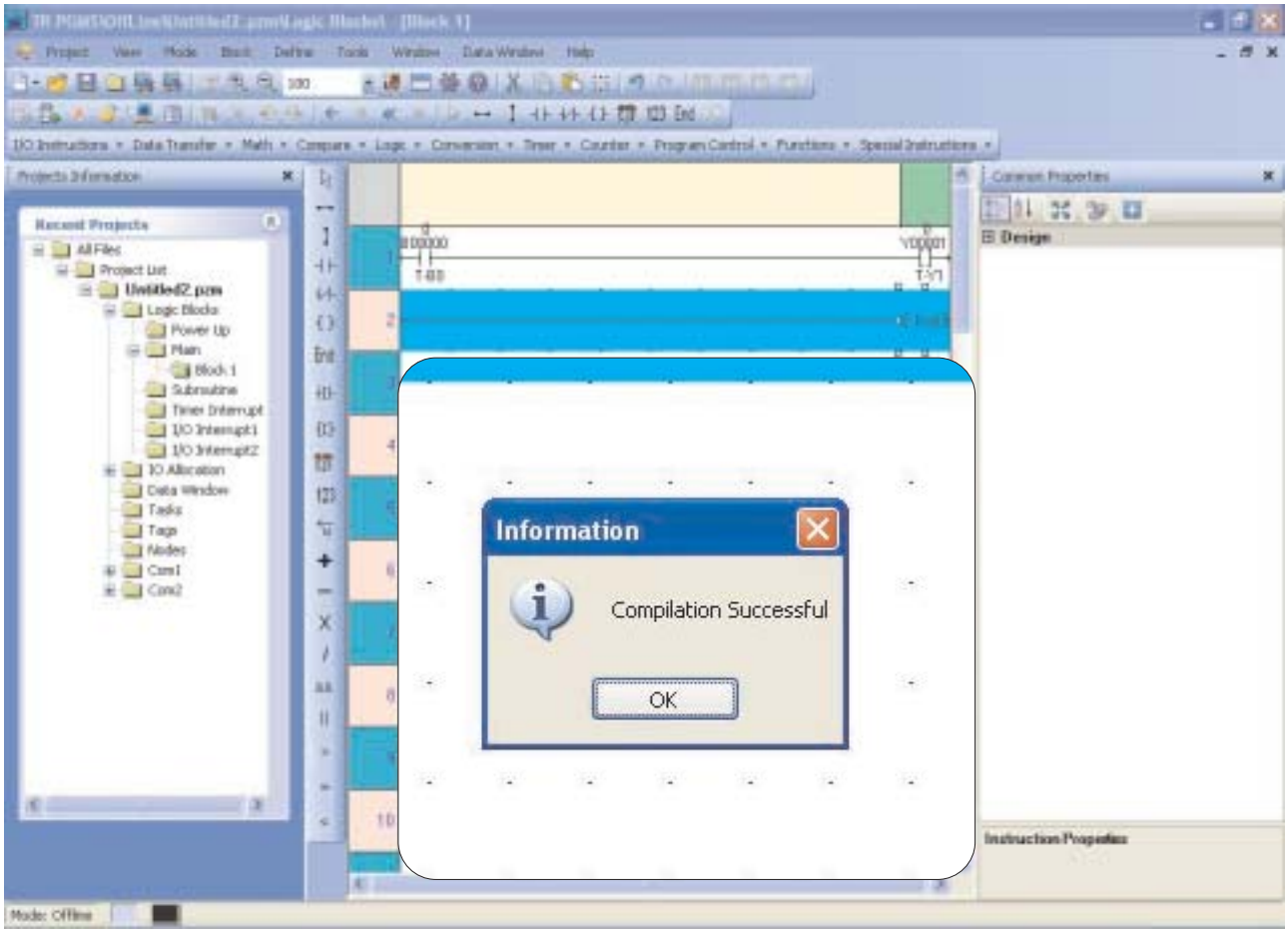

B00000
T-B0
Y00001
T-Y1


B00000
T-B0
Y00001
T-Y1
End

After completing ladder, Compile it as shown below:



Following screen will appears if compilation is successful.



CONFIGURATION

In this chapter. . . .

- Tag Database
- Memory Allocation of Registers

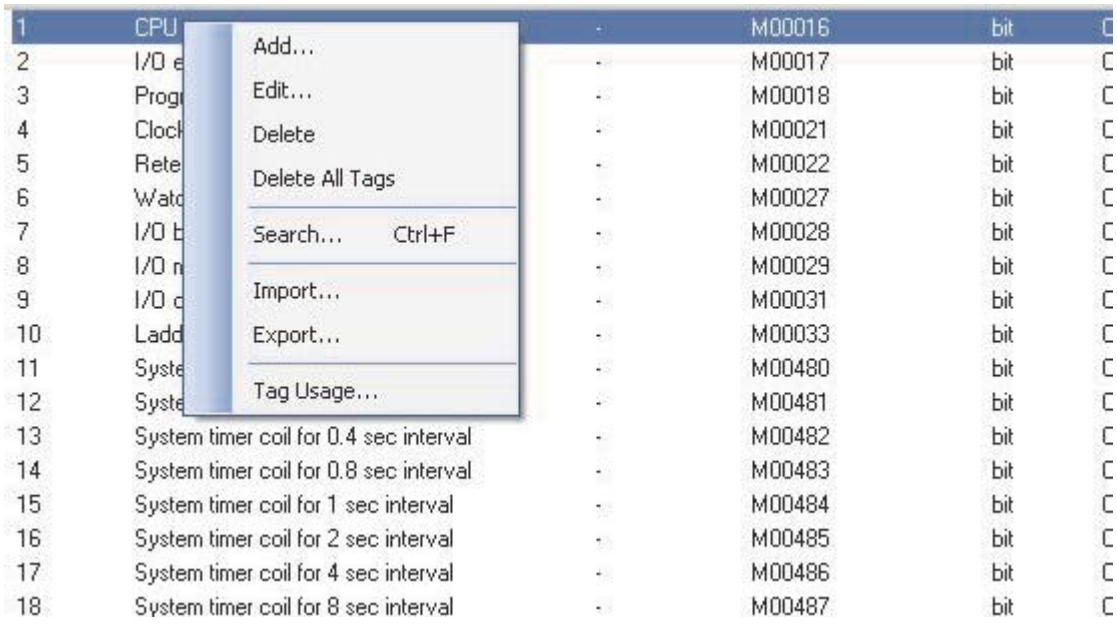
4.1 Tag Database

This is the central database for the tags that need to be used in the application. Once the tags are defined (as register or coils) and their attributes selected, the tags can be used in the application, tasks, etc. This screen helps you to define Tags associated with defined Nodes. A tag is a register, coil or an individual bit of a register. Select the type of tag from the Tag Type field.

If the type of tag selected is a register then the number of bytes required can also be selected. For displaying or editing a floating point data number, the number of bytes must be 4. The Tag Name field is user definable. A tag is not added to the tag list unless a tag name is defined. Once these fields are defined, click on the Add button. The Block field in the tag database defines the starting address of the tag block followed by the block size.

For example : Tag M0214 is within a block (M0214 : 1) whose starting address is M0214 and block size is 1.

This block size is optimized automatically depending on the address of PLC Tag.
Default block size is either 1 or 16. This setting varies from PLC to PLC.
The attributes of existing tag can be changed by highlighting the tag, making the changes, and clicking the Change Tag button. An existing tag can be removed from tag list by clicking on Delete Tag button. Note that removal of tags is possible only if they are not used in any screen.



Add - Use this button to add a tag. After clicking this button, the user has to define the following:
1. Node : Where the tag is located.
2. Register, coil or a bit within a register. Registers can be read only or read/write.
3. The address limits are shown and vary from PLC model to model.
4. Tag name : Each tag needs to have a unique name. The name can be up to 40 characters in length.
5. Byte(s) : If the selected tag is a register, the tag can be defined as a 1 byte (either high or low byte), a 2 byte, or a 4 byte tag.

Edit – Select the tag. Edit the information and then click on the Update button.

Delete - Select the tag and click on Delete button to delete the tag. Before deleting any tag, the user must delete any references to the tag in screens and tasks. Otherwise it can not be deleted.

Default System Tags

Note: Please do not attempt to modify read only system tags in the ladder. This could affect the functionality of the product.

System Registers / Coils:

Register / Coil	Tag Name	Read / Write	Description
SW0003_14	COM1 Status	Read Only	0 = Communication Error; 1= Communicating with PLC
SW0003_15	COM2 Status	Read Only	0 = Communication Error; 1= Communicating with PLC
S0000	Carry Bit	Read/Write	Overflow indication in math operations of ladder and also used in rotate with carry instruction.
SW0010	RTC Day of Month	Read only	RTC day in integer format
SW0011	RTC Month	Read only	RTC month in integer format
SW0012	RTC Year	Read only	RTC year in integer format
SW0013	RTC Hour	Read only	RTC hour in integer format
SW0014	RTC Min	Read only	RTC minute in integer format
SW0015	RTC Sec	Read only	RTC sec in integer format
SW0016	RTC Day of Week	Read only	RTC day of week in integer format
SW0017	Scan time register	Read only	Valu is in multiple of 0.1 mSec. This includes execution time for reading inputs, executing tasks, executing ladder, update outputs, etc. (Refer flow chart)
S0019	Invalid RTC date entry	Read only	0=valid date 1= Invalid date
SW0018	COM1 failed node reconnect time (Sec)	Read/write	Shows time in sec recover the communication with failed nodes for port1.the default value is 60Sec
SW0019	COM2 failed node reconnect time (Sec)	Read/write	Shows time in sec recover the communication with failed nodes for port1.the default value is 60Sec
SW022	COM3 failed node reconnect time (Sec)	Read/write	Shows time in sec recover the communication with failed nodes for port3.the default value is 60Sec
S0021	COM1 failed node reconnect control	Read/write	If this bit is set communication with the failed nodes is detected after scan time SW0018 for port1.By default : ON
S0022	COM2 failed node reconnect control	Read/write	If this bit is set communication with the failed nodes is detected after scan time SW0019 for port2.By default : ON
S0023	COM3 failed node reconnect control	Read/write	If this bit is set communication with the failed nodes is detected after scan time SW0022 for port3.By default : ON
SW64-SW65	Node Status Registers for COM1	Read only	Shows the status of the node, whether node is present or not. Total 2 word Register are mapped for 32 nodes.
SW80-SW81	Node Status Registers for	Read only	Shows the status of the node, whether node is COM2 present or not. Total 2 word Register are mapped for 32 nodes.
SW96-SW111	Node Status Registers for	Read only COM3	Shows the status of the node, whether node is present or not. Total 16 word Register are mapped for 256 nodes. (Not applicable for TRSPUX10A)

SW046	Ladder Scan Time	Read only	Value is multiple of 0.1 mSec
S0034	Ladder Instruction Error Status	Read/Write	Set if Division by zero operation is performed in the ladder instruction and for invalid conditions or operands in case of conversion instructions.

Configuration Words and coils

Register / Coil	Tag Name	Read / Write	Description
MW0000	PLC Operation Mode	Read/Write	Bit0-3: 0: Initialization 1: HALT Mode 2: RUN Mode 3: RUN-F Mode 4: HOLD Mode 6: ERROR Mode.
MW0001	Error Register 1	Read Only	Refer mapped coils M16 to M31
MW0002	Error Register 2	Read Only	Refer mapped coils M32 to M47
MW0003	RUN/STOP Switch Control (Retentive)	Read/Write	1: HALT, 0: RUN. Only LSB is used. other bits (1 to 15) are not used.
MW0005	Digital Filter constant (0 to 150 mS)	Read/Write	Entered Value is multiple of 10 ms. Enabled
MW0010	Configuration Register for Special inputs	Read/Write	
MW0011	Configuration Register for PWM output	Read/Write	
MW0012	Preset values for high Speed Counter	Read/Write	Used to set the preset values for high speed counter
MW0013			
MW0014			
MW0015			
MW0016	Count Values for high Speed Counter	Read/Write	Preset count values of the high speed counters are stored
MW0017			
MW0018			
MW0019			
MW0020	High Speed counter control flags	Read/Write	Control flags for high speed counters
MW0021	Special output control flags	Read/Write	
MW0022	Special Output Control Flags	Read/Write	Control flags for high speed counters
MW0023			
MW0024	Special output Frequency Setting	Read/Write	
MW0025			
MW0030	System Timer Coils	Read Only	Refer mapped coils M00480 to M00487
MW0031	User Interrupt program Status Flags	Read Only	Bit 0 for timer ,Bit 1 for IO1, Bit 2 for IO2. Refer mapped coils M496,M497 & M498 when MW10 bit 16 is ON.
MW0033	Unit IP Address Lo Word	Read Only	Used for Ethernet Model
MW0034	Unit IP Address Hi Word	Read Only	
MW0035	Unit Subnet Mask Address Lo Word	Read Only	
MW0036	Unit Subnet Mask Address Hi Word	Read Only	
MW0037	Unit Default Gateway Lo Word	Read Only	
MW0038	Unit Default Gateway Hi Word	Read Only	
M00016	CPU error	Read Only	ON at error state
M00017	I/O error	Read Only	ON at error state
M00018	Program error	Read Only	ON at error state. This group includes Laader Scan time.

M00021	Clock/calendar illegal value warning	Read Only	ON when clock/calendar data is illegal
M00022	Retentive data invalid warning	Read Only	ON when retentive data in RAM are invalid
M00027	Watchdog timer error	Read Only	ON at error state
M00029	I/O mismatch error	Read Only	ON at error state
M00031	I/O communication error	Read Only	ON at error state
M00033	Ladder Scan time error	Read Only	ON when the scan time exceeds 200ms (default)
M00480	System timer coil for 0.1 sec interval	Read Only	Toggle at 50 % duty cycle
M00481	System timer coil for 0.2 sec interval	Read Only	Toggle at 50 % duty cycle
M00482	System timer coil for 0.4 sec interval	Read Only	Toggle at 50 % duty cycle
M00483	System timer coil for 0.8 sec interval	Read Only	Toggle at 50 % duty cycle
M00484	System timer coil for 1 sec interval	Read Only	Toggle at 50 % duty cycle
M00485	System timer coil for 2 sec interval	Read Only	Toggle at 50 % duty cycle
M00486	System timer coil for 4 sec interval	Read Only	Toggle at 50 % duty cycle
M00487	System timer coil for 8 sec interval	Read Only	Toggle at 50 % duty cycle
M00496	Timer interrupt ladder execution status	Read Only	ON when Timer program is executing
M00497	IO1 interrupt execution status	Read Only	ON when IO1 program is executing
M00498	IO2 interrupt execution status	Read Only	ON when IO2 program is executing
M00512	ALWAYS ON	Read Only	This coil is always ON
M00513	ALWAYS OFF	Read Only	This coil is always OFF

SPECIAL INPUT AND OUTPUT

In this chapter. . . .

- Single Phase Counter
- Single Phase speed-counter
- Quadrature bi-pulse counter
- Interrupt input function
- Pulse Output Function
- PWM Output Function

5 High Speed Counter Design

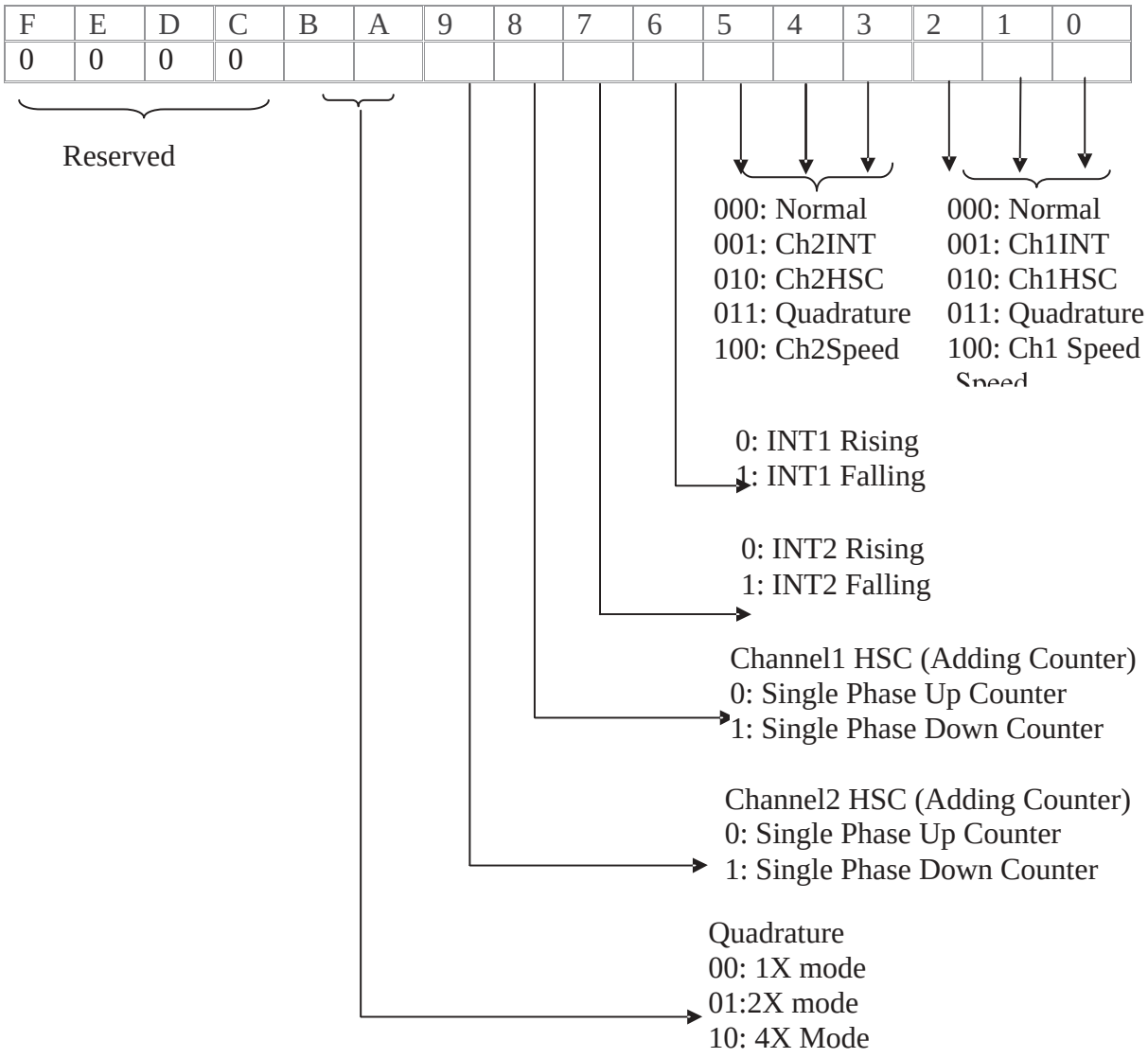
Configuration Registers for Special Function Inputs and PWM outputs:

Register Description	Register Number
Configuration Register for Special inputs	MW10
Configuration Register for PWM output	MW11
Single Phase Counter Set Value Channel 1 Channel 2	 MW12, MW13 MW14, MW15
Count Value Channel 1 Channel 2	 MW16, MW17 MW18, MW19
Soft Gate (Device) Channel 1 Channel 2 Interrupt Enable (Device) Channel 1 Channel 2 Count Preset (Device) Channel 1 Channel 2	 M 320 M 328 M 322 M330 M323 M331
Single Phase Speed Counter Sampling Time Channel 1 Channel 2 Hold Value Channel 1 Channel 2 Soft Gate (Device) Channel 1 Channel 2	 MW12 MW14 MW16, MW17 MW18, MW19 M 320 M 328
Quadrature Bi Pulse Comparision Value1 Comparision Value2 Count Value Soft Gate (Device) Interrupt Enable1 (Device) Count Preset 1 (Device) Interrupt Enable 2 (Device) Count Preset 2 (Device)	 MW12, MW13 MW14, MW15 MW16, MW17 M320 M322 M324 M323 M325
Pulse Output Function Pulse Enable Flag (Device) Frequency Setting Register Frequency Setting Error Flag (Device)	 M336 MW22, MW23 M191

PWM Output Function	
Pulse Enable Flag (Device)	M336
Frequency Setting Register	MW22, MW23
ON duty setting register	MW24, MW25
pulse width error flag	M189
On duty setting error flag	M190
Frequency Setting Error Flag (Device)	M191

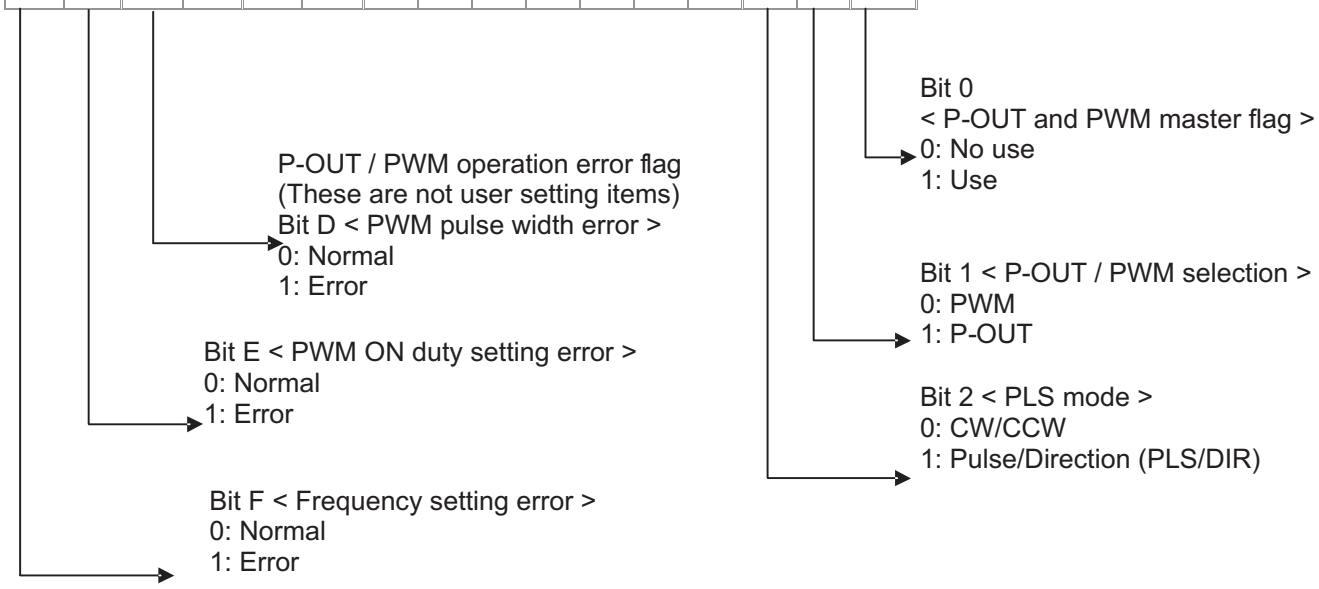
The Mode selection is done through two registers as below.

Configuration Register 10 (High Speed Input): (MW0010).



Configuration Register 11 (Pulse / PWM Output): MW0011

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
			0	0	0	0	0	0	0	0	0	0			



5.1 Single Phase Counter

When the count input is changed from OFF to ON, the count value is increased by 1. When the count value reaches the set value, the count value is reset to 0, and I/O interrupt program is activated (if the interrupt enable flag is ON). The count value is reset to 0 when the reset input comes ON. This counter operation is enabled while the soft-gate is ON. The count value is reset to 0 when the soft-gate is changed from ON to OFF. The set value is set internally at the timing of the soft-gate changing from OFF to ON. When the soft-gate is OFF, count value can be changed by writing the data into the set value register and setting the count preset flag to ON. The count value range is H0000 0000 to HFFFF FFFF (32-bit data).
The high-speed input lines are directly connected to capture pins of coprocessor, so it counts the pulses through capture inputs.

Hardware Condition:
Count input (IP 1 and IP 2)
ON/OFF pulse width: 100 ms or more (max. 100 kHz)
Reset input (X002 and X003)
ON/OFF duration: 2 ms or more

Related Registers:

Function	Register/device		Remarks
	Channel 1	**Channel 2**	
Count input	IP 1	IP 2	
Reset input	IP 3	IP 4	
Set value	MW12 SW13	MW14 MW15	Data range: H0000 0000 to HFFFF FFFF
Count value	MW16 MW17	MW18 MW19	
Soft-gate	M320	M328	Operation is enabled when ON
Interrupt enable	M322	M330	Interrupt is enabled when ON
Count preset	M323	M331	Used to preset the counter value

Note: When both channels are used, IP 1toIP 4 cannot be used as normal input devices. However, if either one channel is used, these inputs for unused channel can be used as normal input devices.

Interrupt assignment
Channel 1 --- I/O interrupt program #1
Channel 2 --- I/O interrupt program #2

5.2 Single Phase speed - counter

This function counts the number of changes of the count input from OFF to ON during the every specified sampling time. The count value in a sampling time is stored in the hold value register. This counter operation is enabled while the soft-gate is ON. When the soft-gate is OFF, the hold value is cleared to 0. The setting range of the sampling time is 1 to 1000 ms (1 ms units). The count value range is H0000 0000 to HFFFF FFFF (32-bit).

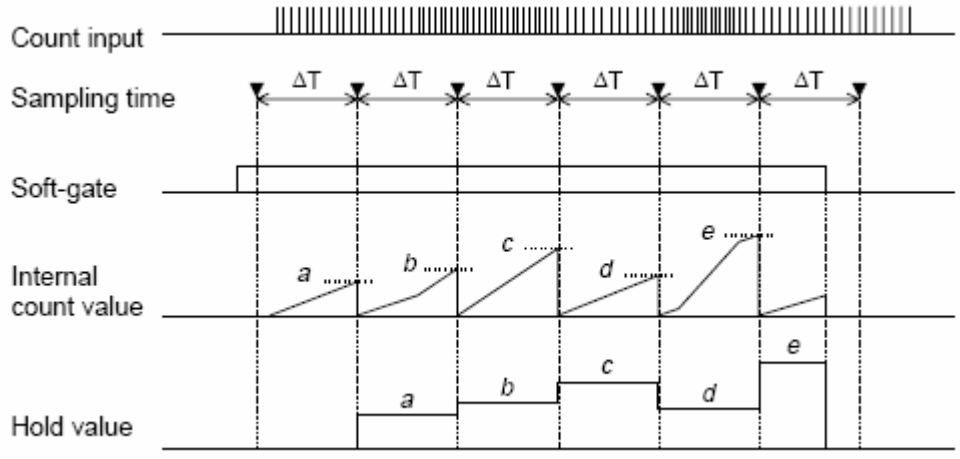
The function selection is done through configuration register1.

Function	Register/device		Remarks
	Channel 1	**Channel 2**	
Count input	IP 1	IP 2	
Sampling time	MW12	MW14	Data range: 1 to 1000
Hold value	MW16	MW18	Data range: H0000 0000 to HFFFF FFFF
Soft-gate	M320	M328	Operation is enabled when ON

Note 1) The setting data range of the sampling time is 1 to 1000. (1 ms multiplier)
Note 2) When both channels are used, IP 1 and IP 2 cannot be used as normal input devices. However, if either one channel is the input for unused channel can be used as normal input devices.

Hardware condition:
Count input (X000 and X001)
ON/OFF pulse width: 100 ms or more (max. 100 kHz)

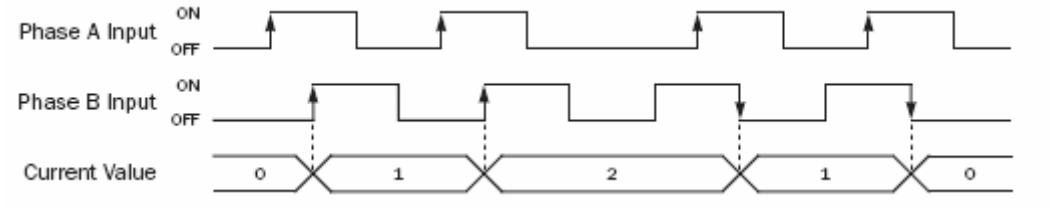
Interrupt assignment:
No interrupt function



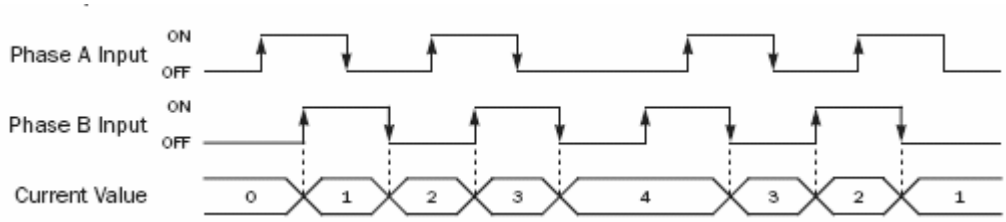
5.3 Quadrature bi-pulse counter

This function counts up or down the quadrature bi-pulse (2-phase pulses whose phases are shifted 90° each other). Counts up when phase A precedes, and counts down when phase B precedes.

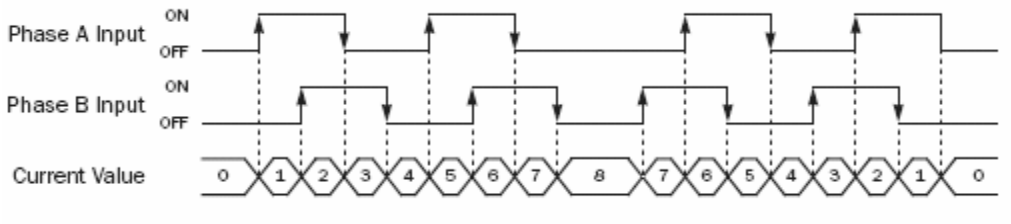
1-edge count:
The current value increments or decrements at the rising or falling edge of the phase B input after the phase A input has turned on.



2-edge Count:
The current value increments or decrements at the rising or falling edge of the phase B input after the phase A input has turned on or off.



4-edge Count:
The current value increments or decrements at the rising or falling edges of the phase A and B inputs.



Both rising and falling edges of each phase are counted.
Consequently, 4 times count value against the pulse frequency is obtained.

When the count value reaches the comparison value 1 (or 2), the I/O interrupt program#1 (or #2) is activated (if the interrupt enable flag for each is ON). This counter operation is enabled while the soft-gate is ON. The count value is reset to 0 when the soft-gate is changed from ON to OFF. The count value is also reset to 0 when the reset input comes ON. When the soft-gate is OFF, the count value can be changed by writing the data into the comparison value 1 (or 2) register and setting the count preset flag 1 (or 2) to ON. The comparison value 1 and 2 can be changed even when the soft-gate is ON. The count value range is 0 to 4294967295 (32-bit data).
Note :- Currently 90 degrees phase shift between inputs is not tested.

The function selection is done through configuration register1

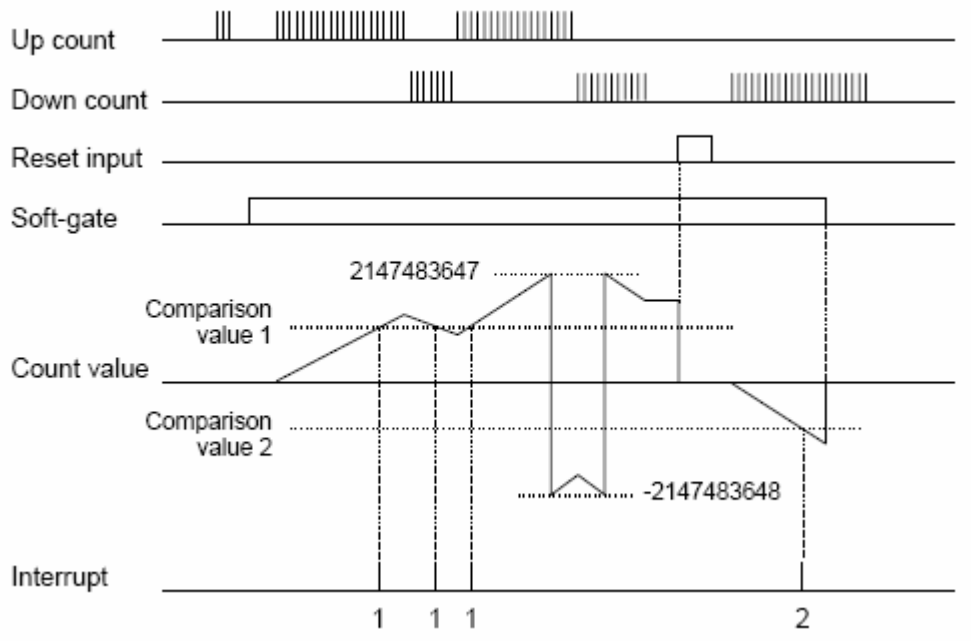
Function	Register/device	Remarks
Phase A	IP 1	
Phase B	IP 2	
Reset input	IP 3	

Function	Register/device	Remarks
Comparison value 1	MW12 MW13	Data range: 0 to 4294967295
Comparison value 2	MW14 MW15	
Count value	MW16 MW17	
Soft-gate	M320	Operation is enabled when ON
Interrupt enable 1	M322	Interrupt 1 is enabled when ON
Count preset 1	M324	Used to preset the count value
Interrupt enable 2	M323	Interrupt 2 is enabled when ON
Count preset 2	M325	Used to preset the count value

Hardware condition:
Phase A and phase B (IP 1 and IP 2)
1X Mode
ON/OFF pulse width: 100 ms or more (max. 50 kHz)
2X Mode
ON/OFF pulse width: 100 ms or more (max. 25 kHz)
4X Mode
ON/OFF pulse width: 100 ms or more (max. 25 kHz)

Reset input (IP3)
ON/OFF duration: 2 ms or more

Interrupt assignment:
Comparison value 1 — I/O interrupt program #1
Comparison value 2 — I/O interrupt program #2



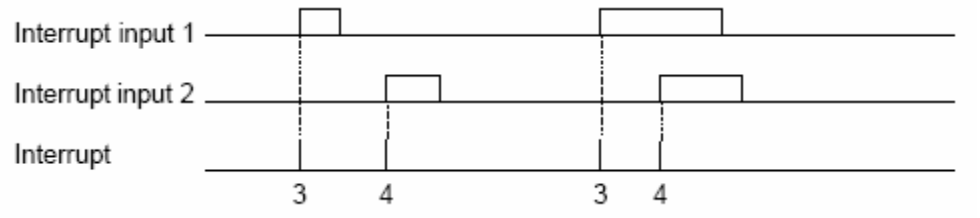
5.4 Interrupt Input Function

When the signal state of the interrupt input is changed from OFF to ON (or ON to OFF), the corresponding I/O interrupt program is activated immediately. Up to 2 interrupt inputs can be used. The interrupt generation condition can be selected either rising edge (OFF to ON) or falling edge (ON to OFF) for each input. The I/O interrupt program #1 is corresponding to the interrupt input 1, and the I/O interrupt program #2 is corresponding to the interrupt input 2.

Hardware condition
Interrupt input (IP 1 and IP 2)
ON/OFF pulse width: 100 ms or more

The function selection is done through configuration register1
When the signal on Capture 1 and Capture 2 input of coprocessor changes it will give interrupt to main CPU (through EXT1 and EXT2 pins of main CPU), and ladder will be executed in the ISR of main CPU.

Interrupt assignment
Interrupt input 1 — I/O interrupt program #1
Interrupt input 2 — I/O interrupt program #2



5.5 Pulse Output Function

Internally we can use one dedicated timer for Pulse and PWM output.

Two timers can be used for two high speed input each.
Each timer has match output pins. There are two transistor outputs Y0 and Y1 and can be used for pulse output.
Each Timer has match output pins. But any one of this can be selected at a time. The selection of this is done through PINSEL register.

These two match output pins can be given to these outputs Y0 and Y1.
When CW/CCW mode is selected if frequency is positive, match output 1 will be selected so that pulses will be out on Y0 and if frequency is negative match output 2 will be selected so that pulses will be out on Y1.
In PULSE/DIR mode the pulses will be out on Y0 i.e. Match output1. If the frequency is negative then direction pin can be set to high through Match output 2.

Function		Register/device	Remarks
CW/ CCW	PLS/DIR		
CW Pulse	PLS	Y0	
CCW Pulse	DIR	Y1	
Pulse enable flag		M336	Output is enabled when ON
Frequency setting register		MW22 MW23	Data range: -5000 to –50, 50 to 5000
Frequency setting error flag		M191	ON at error (Reset OFF automatically)

5.6 PWM Output Function

This function is used to output a variable duty cycle pulse train. The controllable duty cycle is 0 to 100 % (1 % units). The PWM output is enabled when the pulse enable flag is ON. While the pulse enable flag is ON, the duty cycle (ON duty) can be changed by changing the duty setting value (0 to 100). The frequency setting is available in the range of 50 to 5000 Hz (1 Hz units) before turning ON the pulse enable flag. The frequency changing is not allowed while the pulse enable is ON. Note that the minimum ON/OFF pulse duration is 100 ms. Therefore, the controllable ON duty range is limited depending on the frequency setting as follows. If the ON duty setting value is not available (within 0 to 100), the pulse width error flag comes ON. (PWM output operation is continued but the duty cycle is not guaranteed)

The function selection is done through configuration register2

Function	Register/device	Remarks
PWM pulse	Y01	
Pulse enable flag	M336	Output is enabled when ON
Frequency setting register	MW20 – MW21	Data range: 50 to 5000
ON duty setting register	MW22 –MW23	Data range: 0 to 100
Pulse width error flag	M189	ON at error (reset OFF automatically)
ON duty setting error flag	M190	ON at error (reset OFF automatically)
Frequency setting error flag	M191	ON at error (reset OFF automatically)

The Buffer is updated at each scan, so that the PWM frequency and duty cycle will be changed after each scan.

OPERATING SYSTEM OVERVIEW

In this chapter. . . .

- Operating Modes

6.1 Operating System Overview

The TR base models has three basic operation modes, the RUN mode, the HALT mode and the ERROR mode. It also has the HOLD and RUN-F modes mainly for system checking.

RUN: The RUN mode is a normal control-operation mode.
In this mode, the TR base model reads external signals, executes the user program, and outputs signals to the external devices according to the user program. It is in the RUN mode that the TR base performs scans the user program logic, which is the basic operation of a PLC. In this mode task defined in the application are also executed.

HALT: The HALT mode is a programming mode.
In this mode, user program execution is stopped and all outputs are brought to the “Halt State Output Condition” defined in the application. Program loading into the TR base unit is possible in the HALT mode.

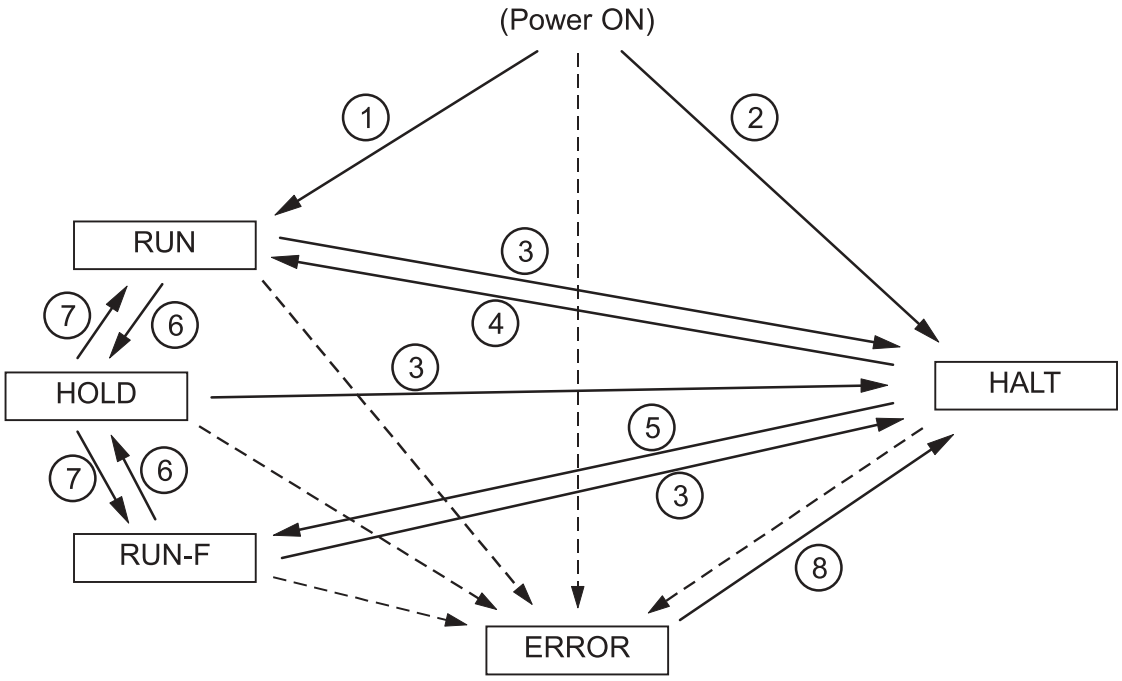
ERROR: The ERROR mode is a shutdown mode as a result of self-diagnosis.
The TR base model enters the ERROR mode if internal trouble is detected by self-diagnosis. In this mode, program execution is stopped and all outputs are brought to “Error State Output Condition” defined in the application. The cause of the shutdown can be confirmed by connecting the programming tool.
To exit from the ERROR mode, execute the Error Reset command from the programming tool, or cycle power off and then on again.

HOLD: The HOLD mode is provided mainly for checking the external I/O signals.
In this mode, user program execution is stopped, with input and output updating is executed. It is therefore possible to suspend program execution while holding the output state. Moreover, a desired output state can be established by setting any data by using the programming tool.

RUN-F: The RUN-F mode is a forced RUN mode provided for program checking.
This mode is effective when using the expansion I/Os.
Deferent from the normal RUN mode, the RUN-F mode allows operation even if the registered I/O modules are not actually mounted.
In this mode the physical outputs are not updated; only the registers are updated.

The operation modes are switched by the mode control switch provided on the TR base model and the mode control commands issued from the programming tool.

The mode transition conditions are shown below:



1. Mode control switch is in R (RUN) side.
2. Mode control switch is in H (HALT) side.
3. Mode control switch is turned to H (HALT) side, or HALT command is issued from the programming tool.
4. Mode control switch is turned to R (RUN) side, or RUN command is issued from the programming tool.
5. Force RUN (RUN-F) command is issued from the programming tool.
6. HOLD command is issued from the programming tool.
7. HOLD Cancel command is issued from the programming tool.
8. Error Reset command is issued from the programming tool.

– – → (dotted line) Error is detected by self-diagnosis.

Note:
The commands from the programming tool are available when the mode control switch is in R (RUN) side.

PROGRAMMING INFORMATION

In this chapter. . . .

- Devices and registers
- Index modifications
- Real-time clock/calendar
- I/O Allocation
- TR Memory mode settings
- User Program Configuration
- Pragramming Language
- Program execution Sequence
- On-line debug support functions

7.1 Devices Registers

Broadly two types of registers are present in PLC register database:

1. Internal PLC Registers: Implemented through buffers present in RAM of Base module.
   - Data Registers (D).
   - Auxillary Registers (BW/B).
   - System Registers (SW).
   - System coil (S).
   - Timer Registers (T).
   - Counter Registers (C).
   - Base module configuration Registers (MW/M) (Coils and registers are mapped)
   - I/O Registers of Base Module (XW/X, YW/Y) (Coils and registers are mapped)
   - Timer devices (T.)
   - Counter devices (C.)

When COM ports are configured as Modbus slave, the internal PLC tags are mapped to the modbus address as given in the following table:

PLC Tag description	Reg. Addressing	Bit Addressing	Modbus address
I/O register	XW(400)	X (6400)	440001 - 440400
	YW(400)	Y (6400)	441001 - 441400
Internal registers	BW00-BW255	B0000 to B4095	442001 - 442256
System Registers	SW00-SW256	Not Mapped	420001 - 420256
Timer Registers	T00-T255	Not Mapped	400001 - 400256
Counter Register	C00-C255	Not Mapped	410001 - 410256
Data Registers	D0000-D4095	Not Mapped	450001 - 454096
Retentive Registers	R0 - R1399	Not Mapped	430001 - 431400
Index Register (I,J,K)	I	Not Mapped	443001
	J	Not Mapped	443002
	K	Not Mapped	443003
Configuration MW registers	MW(1600)	M(25600)	460001-461600

COILS

PLC Tag description	Reg. Addressing	Bit Addressing	Modbus address
Input Coil (R)	---	X (6400)	000001 - 006400
Output Coil (R/W)	---	Y (6400)	010001 - 016400
System Coil (R/W)	---	S 0000 to S 0099	020001 - 020100
Internal Coil (R/W)	---	B 0000 to B 1023	030001 - 034096
Timer Devices (256 bits = 16 words)	---	T. 000 to T. 255	021001 - 021256
Counter Devices (256 bits = 16 words)	---	C. 000 to C. 255	022001 - 022256
Configuration coils	---	M(25600)	035001 - 060600

2. Expansion and Serial I/O Registers: These are external to the unit and can be accessed by communicating with external module over SPI or serial:

I/O Registers of expansion module and serial module (XW/X, YW/Y).
Configuration Registers (MW/M).

XW, YW, MW, X, Y, M register types of both the register types; viz: base, expansion and serial are encoded with the following addressing scheme:

XWssrr YWssrr MWssrr	ss: Slot Number rr: register number in slot ss
Xssccc Yssccc Mssccc	ss: Slot Number ccc: coil number in slot ss

Note:
"0" (Zero) is the slot number of base module.

7.2 Memory Allocation of XW, YW and MW

Memory for XW, YW and MW registers for particular model is allocated by software at the time of IO allocation. The number of XW, YW and MW for the particular model is as per the table given below:

Sr. No.	Model Name	Description	XW	YW	MW	X	Y
1	TRSPUX10A	TR PGM Base Module	1	1	60	8	8
2	TRSPUX10E	TR PGM Base Module with Ethernet	0	0	60	0	0
3	TRSDIX1600	16 Input Digital Module	1	0	0	16	0
4	TRSDOX0016P	16 PNP type transistor output digital module	0	1	0	0	16
5	TRSDOX0016N	16 NPN type transistor output digital module	0	1	0	0	16
6	TRSROX0016	16 Relay type output digital module	0	1	0	0	16
7	TRSDIO0808P	8 Digital input, 8 PNP type transistor output digital module	1	1	0	8	8
8	TRSDIO0808N	8 Digital input, 8 NPN type transistor output digital module	1	1	0	8	8
9	TRSDRO0808	8 Digital input, 8 Relay type output digital module	1	1	0	8	8
10	TRSADX0800	0-10 VDC or 4-20 mA (16 Bit) 8 channel input model	8	0	40	0	0
11	TRSDAX0004	0-10 VDC or 4-20 mA (16 Bit) 4 channel output model	0	4	20	0	0
12	TRSRTX0800	PT100 RTD (16 Bit) 8 channel input model	8	0	40	0	0
13	TRSAIO0402	4 Universal Analog Inputs (RTD, TC, 4-20 mA, 0-20mA,0-50mV, 0-100mV, 0-10VDC) (16 Bit), 2 channel Voltage/Current (16 Bit) outputs.	4	2	30	0	0

The allocation is sequential. If any particular model does not have XW / YW / MW defined then the memory is not allocated in the array for that model. This array is sequentially mapped to Modbus registers.

Consider the example that user has configured the models as below:

Slot 0	:	TRSPUX10A	:	XW : 1,	YW : 1,	MW : 60
Slot 1	:	TRSDRO0808	:	XW : 1,	YW : 1,	MW : 0
Slot 2	:	TRSROX0016	:	XW : 0,	YW : 1,	MW : 0
Slot 3	:	TRSDIO0808N	:	XW : 1,	YW : 1,	MW : 0
Slot 4	:	TRSDIX1600	:	XW : 1,	YW : 0,	MW : 0
Slot 5	:	TRSADX0800	:	XW : 8,	YW : 0,	MW : 40

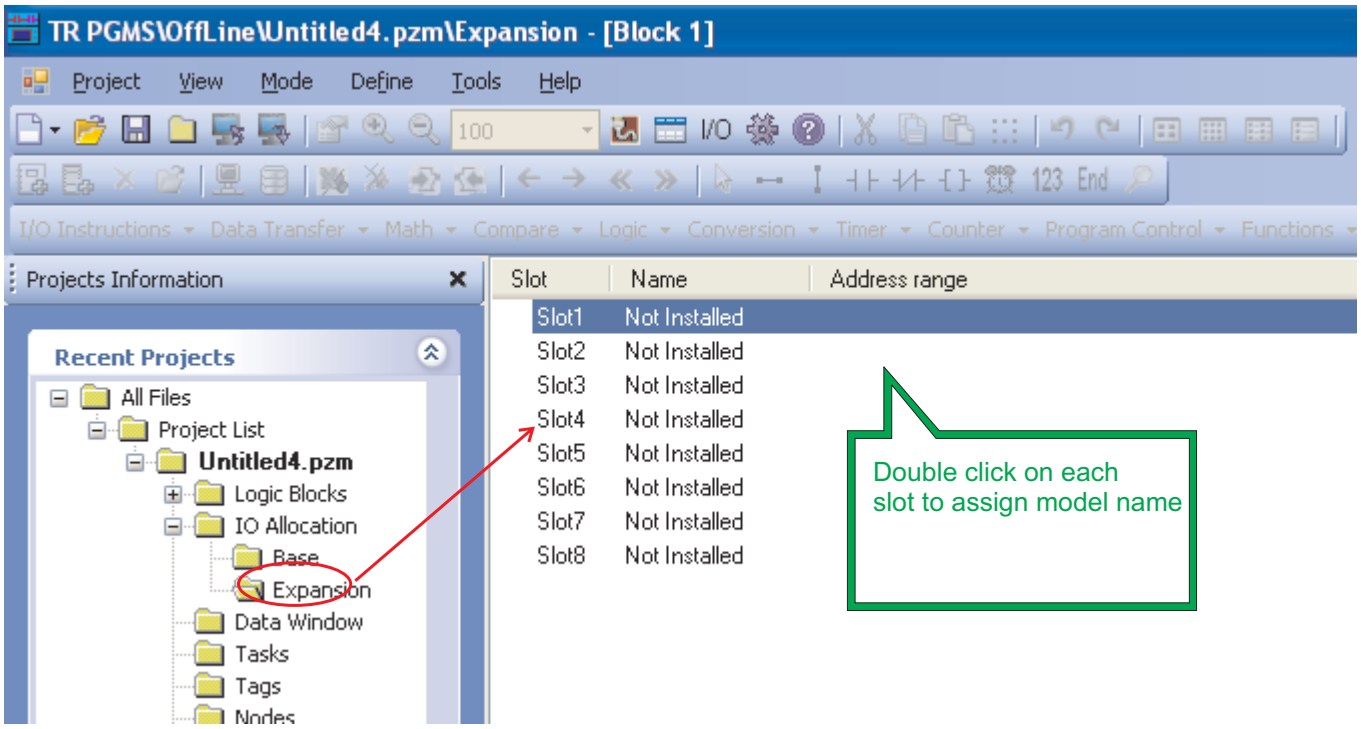
Then the array of XW, YW and MW will be as follows:

XW	Allocated for register
0	TRSPUX10A (XW0000)
1	TRSDRO0808 (XW0100)
2	TRSDIO0808N (XW0300)
3	TRSDIX1600 (XW0400)
4	TRSDIX1600 (XW0400)
5	TRSDIX1600 (XW0400)
6	TRSADX0800 (XW0500)
7	TRSADX0800 (XW0501)
8	TRSADX0800 (XW0502)
9	TRSADX0800 (XW0503)
10	TRSADX0800 (XW0504)
11	TRSADX0800 (XW0505)
12	TRSADX0800 (XW0506)
13	TRSADX0800 (XW0507)
14	Not used
….	Not used
399	Not used

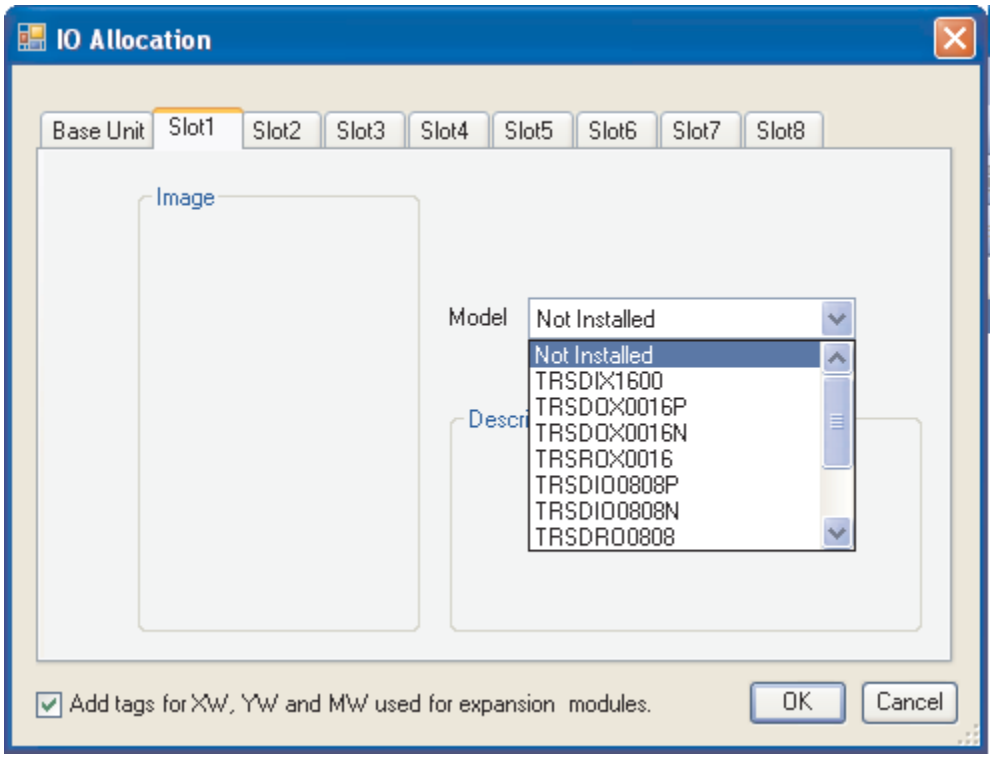
YW	Allocated for register
0	TRSPUX10A (YW0000)
1	TRSDRO0808 (YW0100)
2	TRSROX0016 (YW0200)
3	TRSDIO0808N (YW0300)
4	Not used
….	Not used
….	Not used
399	Not used

MW	Allocated for register
0 to 59	TRSPUX10A (MW0000 to MW0059)
60 to 99	TRSADX0800 (MW0500 to MW0559)
100	Not used
….	Not used
….	Not used
1599	Not used

You can allot “ss” (slot number) from “Project Information” docker window; “IO Allocation\Local” section as shown below:

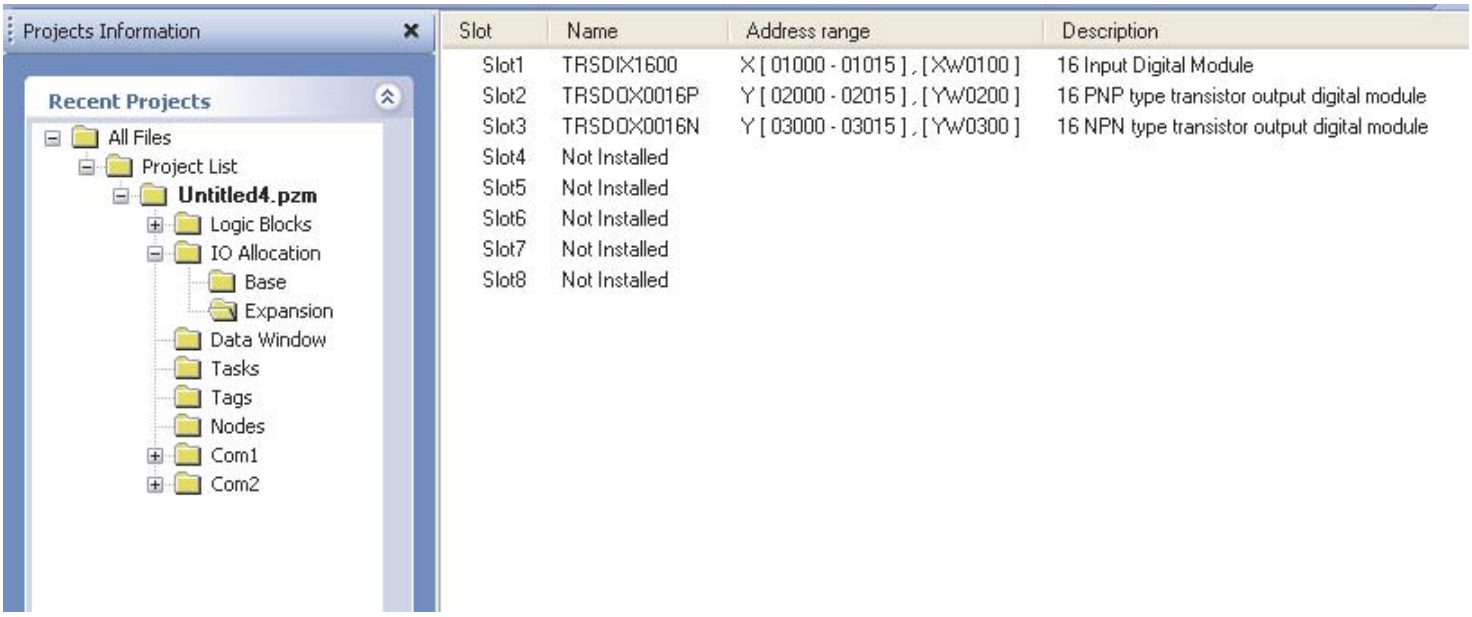


When you double click on the highlighted slot section; below shown window will appear:



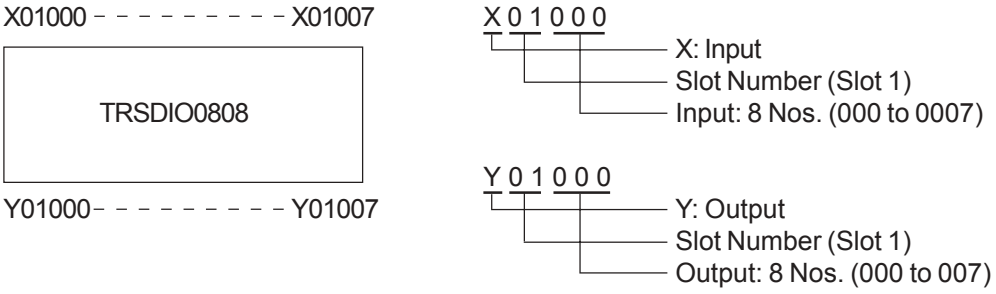
Note: Here you have to allott slots seriallly only and if you tried to allott randomly; it will show an error as “Expansion Modules for PLC are sequencial hence, previous slot can not be empty”

Thus, you can assign the expansion models as per your requirement as follows:



In the above shown screen, you can observer that the address range for the expansion models assign for Slot 1 through Slot 4, it has taken first two digit as 01, 02, 03 & 04 serially.
And last three digit will indiacate the register numbers.

The external input signals are allocated to the external input devices/registers (X/XW).
The external output signals are allocated to the external output devices/registers (Y/YW).
The register numbers of the external input and output registers are consecutive. Thus one register number can be assigned for either input or output.



7.3 Index Modification

When registers are used as operands of instructions, the method of directly designating the register address as shown in Example 1) below is called ‘direct addressing’.

As opposed to this, the method of indirectly designating the register by combination with the contents of the index register (I, J, or K) as shown in Example 2) below is called ‘indirect addressing’. In particular, in this case, since the address is modified using an index register, this is called ‘index modification’.

Example - 1)

Data transfer instruction
Transfer data of BW010 to D1000

Example - 2)

Data transfer instruction (with index modification)
Transfer data of BW(10 + I) to D(0000 + J)
(If I = 3 and J = 200, the data of BW13 is transferred to D0200).

There are 3 types of index register, I, J and K. Each type processes 16-bit integers (-32768 to 32767). There are no particular differences in function between these 3 types of index register.

There is no special instruction for substituting values in these index registers. These are designated as destination of data transfer instructions, etc.

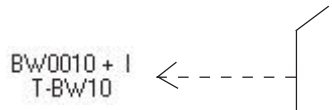
(substitutes 64 in index register I)

(substitutes the data of D0035 in index register J)

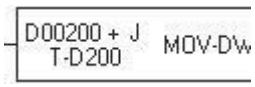
(substitutes the result of addition in index register K)

Note:
(1) The index modification is available for RW, T, C and D registers.
(2) If index registers are used as a double-length register, only the combinations J×I and K×J are allowed.

The followings are examples of index modifications:



When I = 0, it designates BW10.
When I = 1, it designates BW11.
When I = -1, it designates BW09.
When I = 10, it designates BW20.
When I = -10, it designates BW00.



When J = 0, it designates D0201×D0200.
When J = 1, it designates D0202×D0201.
When J = 2, it designates D0203×D0202.
When J = -1, it designates D0200×D0199.
When J = -2, it designates D0199×D0198.

Note:
Be careful that the registers do not exceed the address range by the index modification. The address range is not checked by the unit.

Substitutions of values into index registers and index modifications can be used any times in a program. Normally, the program will be easier to see if a value substitution into an index register is positioned immediately before the index modification.

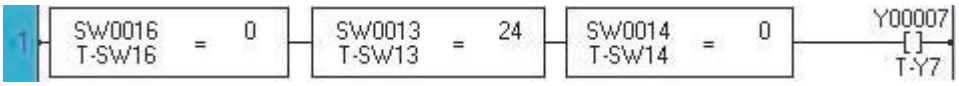
7.4 Real-time clock / calendar

The TR base model is equipped with the real-time clock/calendar for year, month, day, day of the week, hour, minute, and second. These data are stored in the special registers SW10 to SW16 by unsigned integer format as follows:

	F 8	7 8	
D0050	00	Year	00 to 99 (2000 - 2099)
D0051	00	Month	01 to 12
D0052	00	Day	01 to 31
D0053	00	Hour	00 to 23
D0054	00	Minute	00 to 59
D0055	00	Second	00 to 59

→ Calendar LSI

Program example:
In the following circuit, output Y007 turns ON for 1 minute at every Sunday 6 pm.



Clock/calendar back-up:
The clock/calendar continues updating even while the power to the TR unit is off by built-in battery. Its buck-up period is as follows:

Temperature	Backtime
25°C	20 Years

Setting the clock/calendar:
You can set the clock/calendar data, by using the Calendar Set instruction (CLND) in the user program.

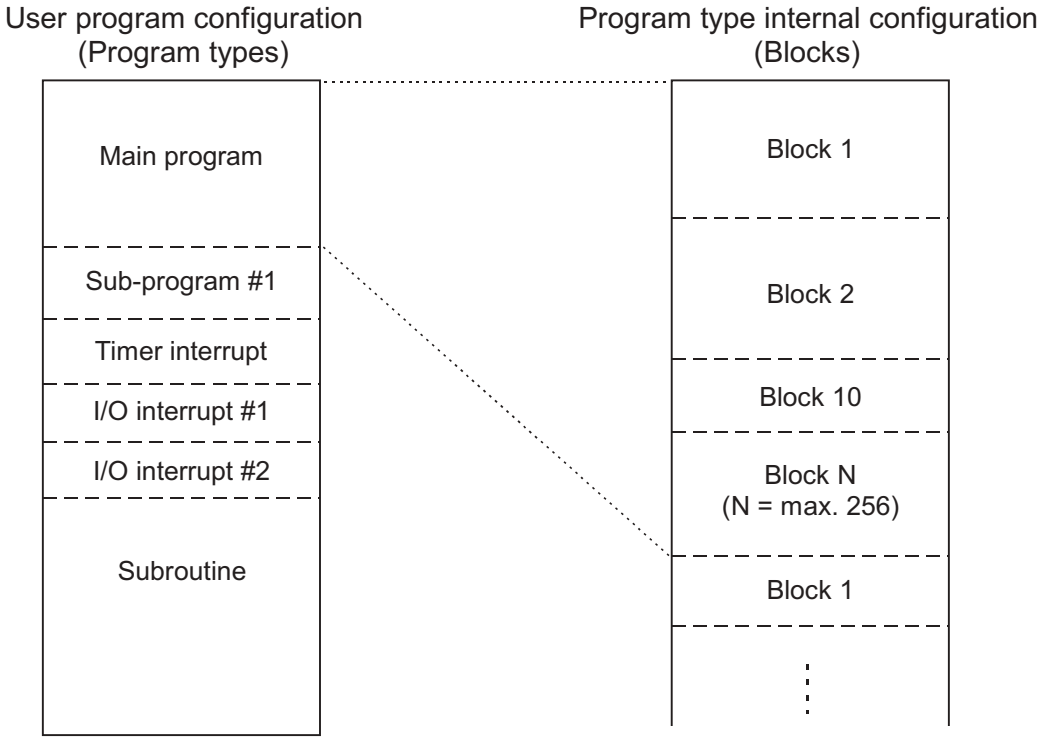
7.5 System Information

System information is the area which stores execution control parameters. The following contents are included in the system information:

(1) Machine parameters (hardware type, memory type)
(2) User program information (program ID, system comments, number of steps used)
(3) Retentive register area information
(4) TR unit program memory mode
(5) Execution control parameters (scan mode, timer interrupt interval)
(6) Communication setting
(7) I/O allocation table

The system information is stored in the built-in EEPROM. Therefore, when these information is modified, the EEPROM write operation is necessary. Otherwise, these are over-written by original EEPROM contents at the next initial load timing.

User program:
The user program is stored by each program types as shown in the following diagram and is managed by units called blocks in each program types.



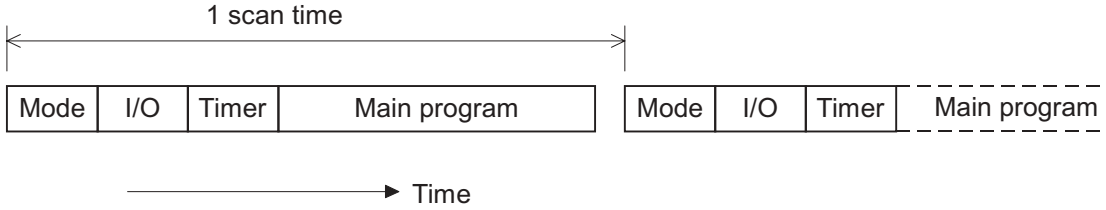
In the user program, the main program is the core. The scan operation explained is for the main program. The operation of other program types are explained in the following sections:
The following 6 program types are supported by the TR unit.

(1) Main program
(2) Sub-program #1
(3) Timer interrupt program
(4) I/O interrupt program #1
(5) I/O interrupt program #2
(6) Subroutine

The blocks are just separators of the program, and have no effect on the program execution. However, by dividing the user program into some blocks, the program becomes easy to understand. The block numbers need not be consecutive. In each program type and block, there is no limit of program capacity. The only limit is the total capacity.

7.5.1 Main Program

The main program is the core of the user program. It is executed once in each scan.



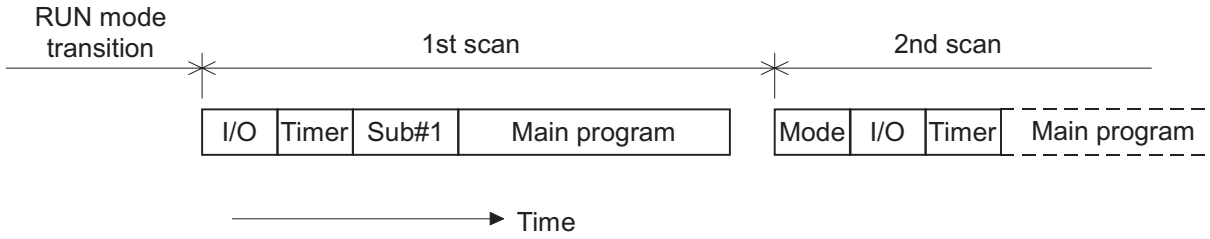
In the above figure,
Mode means the mode control operation
I/O means the I/O update processing
Timer means the timer up date processing
Main program means the main program execution
the self-diagnostic check and peripheral support are omitted in this figure.

The end of the main program is recognized by the END instruction. Although instructions may be present after the END instruction, these portions will not be executed.

7.5.2 Power-up program # 1

If the power-up program #1 is programmed, it is executed once at the beginning of the first scan (before main program execution). Therefore, the sub-program #1 can be used to set the initial value into the registers. The sub-program #1 is called the initial program.

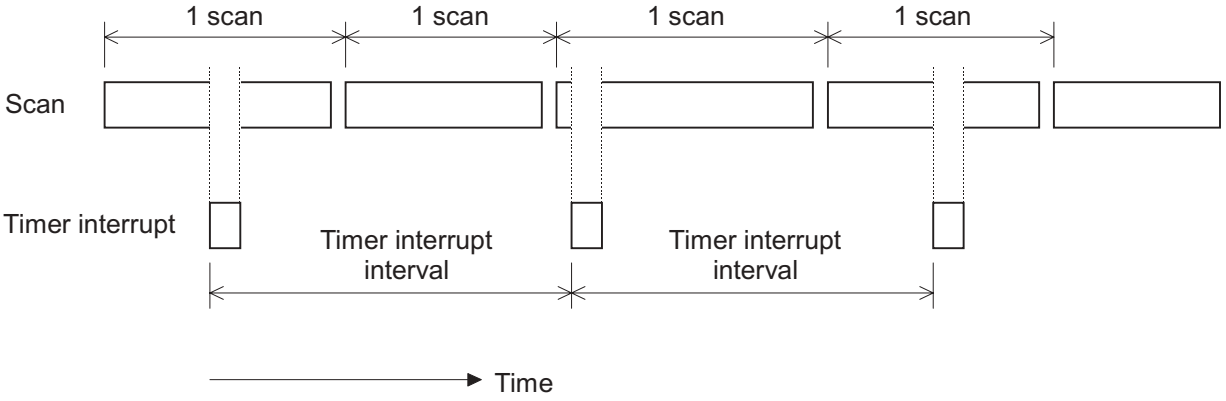
The figure below shows the first scan operation.



The end of the sub-program #1 is recognized by the END instruction.

7.5.3 Timer interrupt program

The timer interrupt is the highest priority task. It is executed cyclically with a user specified interval, with suspending other operation.
The interrupt interval is set in the system information. (5 to 1000 ms, 5 ms units).



The end of the timer interrupt is recognized by the IRET instruction.

7.5.4 I/O interrupt program

The I/O interrupt program is also the highest priority task. It is executed immediately when the interrupt factor is generated, with suspending other operation.
The following 2 types I/O interrupt programs are supported in the TR unit.

(1) I/O interrupt #1
The I/O interrupt #1 is used with the high speed counter function. When the count value reaches the preset value, etc., the I/O interrupt #1 is activated immediately with suspending other operation. The end of the I/O interrupt #1 is recognized by the IRET instruction.

(2) I/O interrupt #2
The I/O interrupt #2 is also used with the high speed counter function.

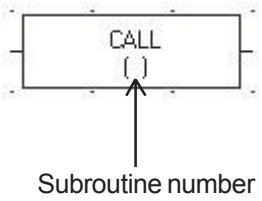
If an interrupt factor is generated while other interrupt program is executing (including the timer interrupt), the interrupt factor is held. Then it will be activated after finishing the other interrupt program execution.

If two or more interrupt factors are generated at the same time, the priority is as follows:
Timer > I/O #1 > I/O #2

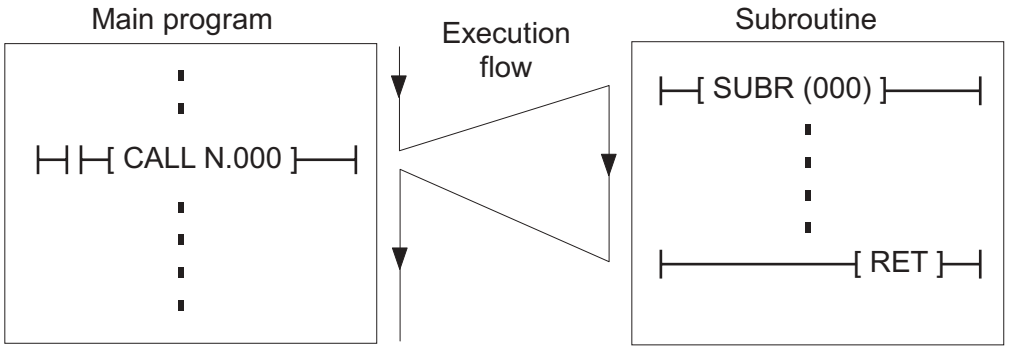
7.5.5 Subroutines

In the program type ‘Subroutine’ total 256 numbers of subroutine can be programmed.
The subroutine is not a independent program. It is called from other program types (main program, sub-program, interrupt program) and from other subroutines.

One subroutine is started with the CALL instruction, and ended by the RET instruction.
It is necessary to assign a subroutine number to the CALL instruction.



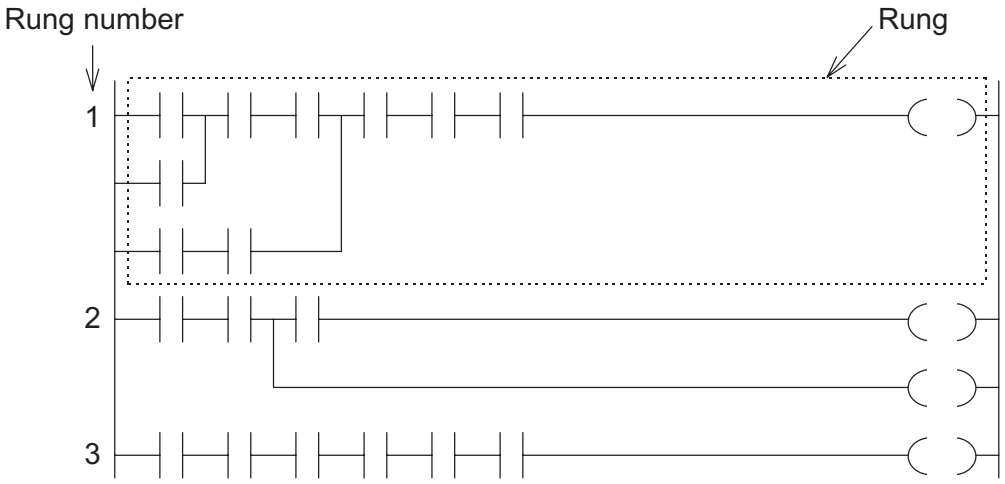
The RET instruction has no subroutine number.



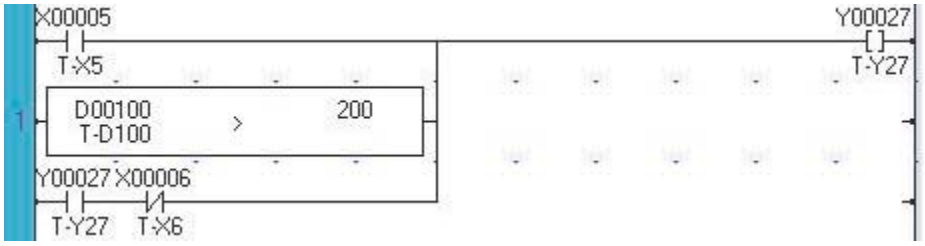
7.6 Programming Language

The programming language of the TR unit is ‘ladder diagram’. Ladder diagram is a language which composes program using relay symbols as a base in an image similar to a hard-wired relay sequence. In the TR unit, in order to achieve an efficient data-processing program, ladder diagram which are combinations of relay symbols and function blocks are used.

The ladder diagram program is constructed by units called ‘rung’. A rung is defined as one network which is connected each other.



The rung numbers are a series of numbers (decimal number) starting from 1, and cannot be skipped. There is no limit to the number of rungs.
The size of any one rung is limited to 50 lines X 11 columns.
A example of a ladder diagram program is shown below.



When X005 is ON or the data of D0100 is greater than 200, Y027 comes ON. Y027 stays ON even if X005 is OFF and the data of D0100 is 200 or less.
Y027 will come OFF when X006 comes ON.

7.7 Program execution sequence

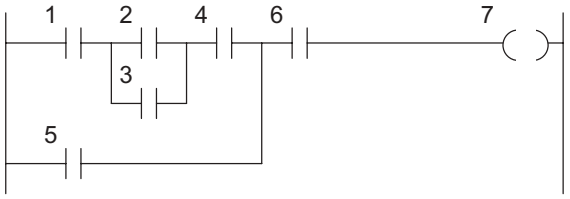
The instructions execution sequence is shown below.
(1) They are executed in the sequence from block 1 through the final block which contains the END instruction (or IRET in an interrupt program).

(2) They are executed in the sequence from rung 1 through the final rung in a block (or the END instruction).

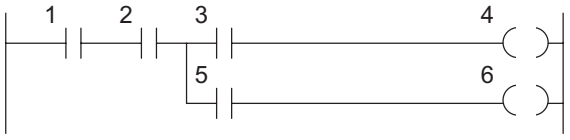
(3) They are executed according to the following rules in any one rung.

① When there is no vertical connection, they are executed from left to right.

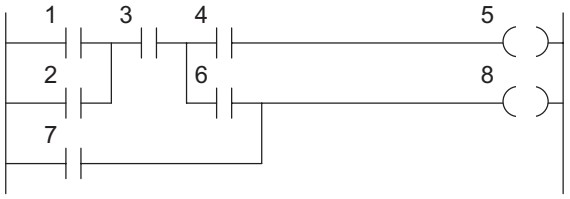
② When there is an OR connection, the OR logic portion is executed first.



③ When there is a branch, they are executed in the order from the upper line to the lower line.



④ A combination of ② and ③ above.



The instructions execution sequence in which function instructions are included also follows the above rules. However, for program execution control instructions, such as jumps (JCS), loops (FOR-NEXT), subroutines (CALL-SUBR-RET), it will depend the specifications of each instruction.

TROUBLESHOOTING

In this chapter. . . .

- Troubleshooting Procedure
- Self Diagnostic Item

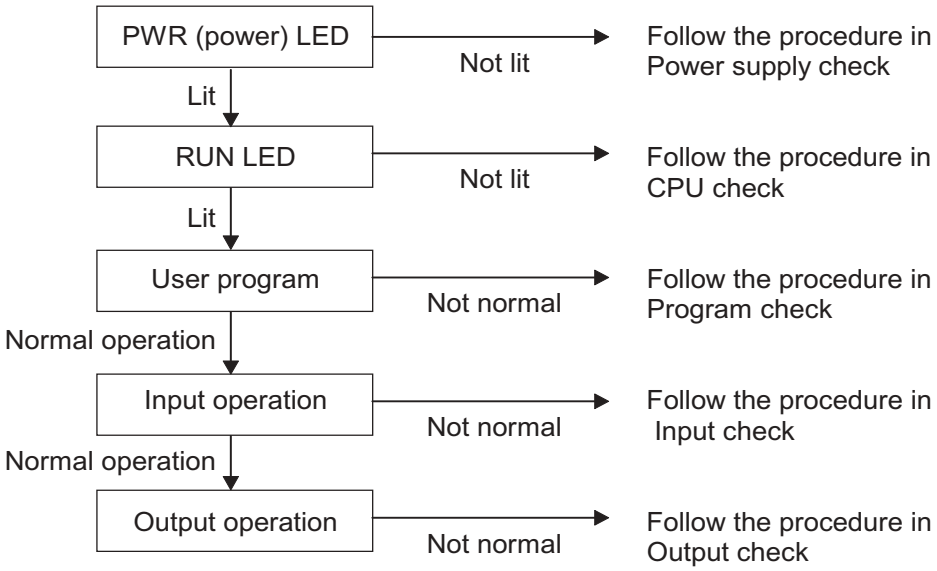
8.1 Troubleshooting Procedure

CAUTION

1. Pay special attention during the troubleshooting to minimize the risk of electrical shock.
2. Turn off power immediately if the TR unit or related equipment is emitting smoke or odor. Operation under such situation can cause fire or electrical shock.
3. Turn off power before removing or replacing units, modules, terminal blocks or wires. Failure to do so can cause electrical shock or damage to the PLC and related equipment.
4. Contact factory for repairing if the TR basic unit or related equipment is failed. Toshiba will not guarantee proper operation nor safety for unauthorized repairing.

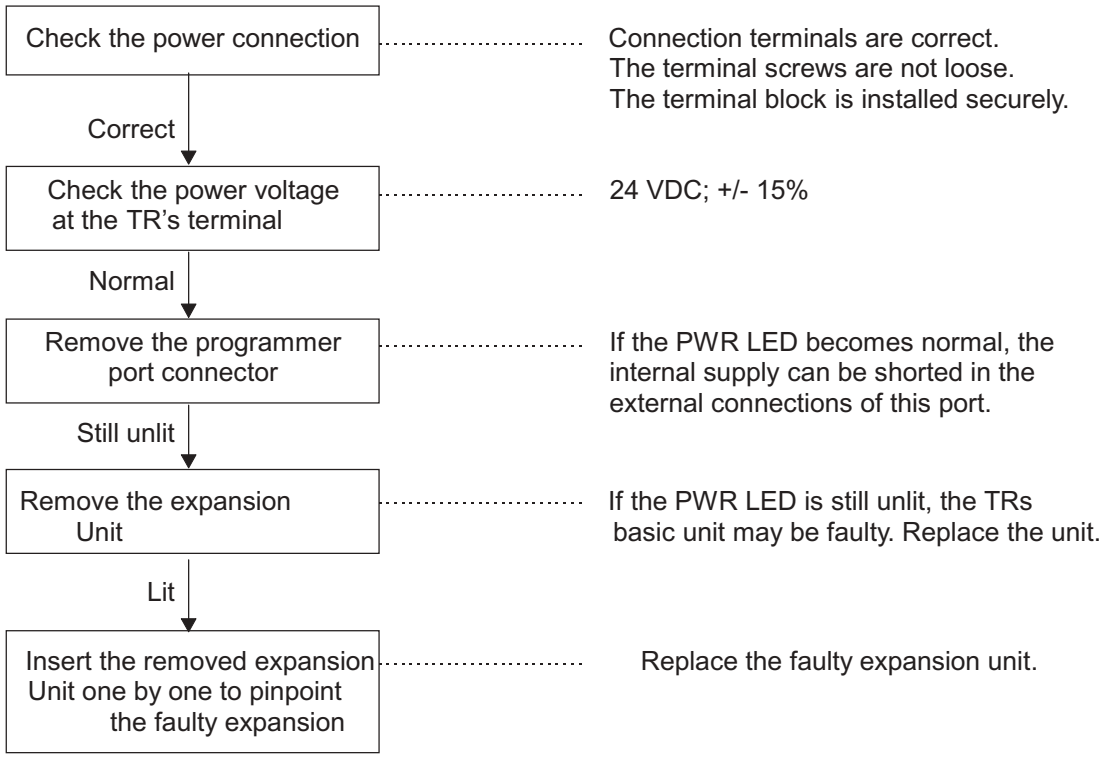
If a trouble occurs, determine whether the cause lies in the mechanical side or in the control system (PLC) side. A problem may cause a secondary problem, therefore, try to determine the cause of trouble by considering the whole system.

If the problem is found in the TR base PLC model, check the following points:



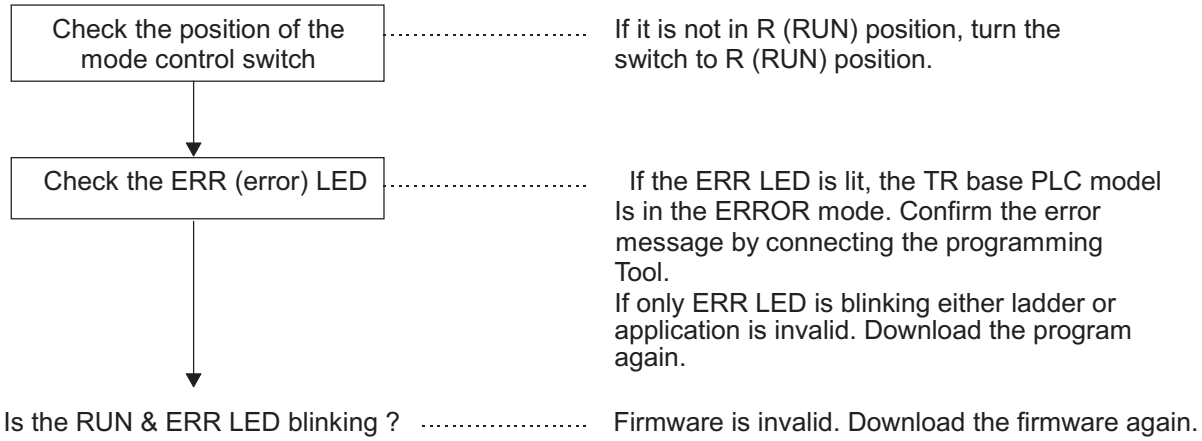
8.1.1 Power Supply Check

If the PWR (power) LED is not lit after power on, check the following points.



8.1.2 CPU Check

If the RUN LED is not lit after power on, check the following points.



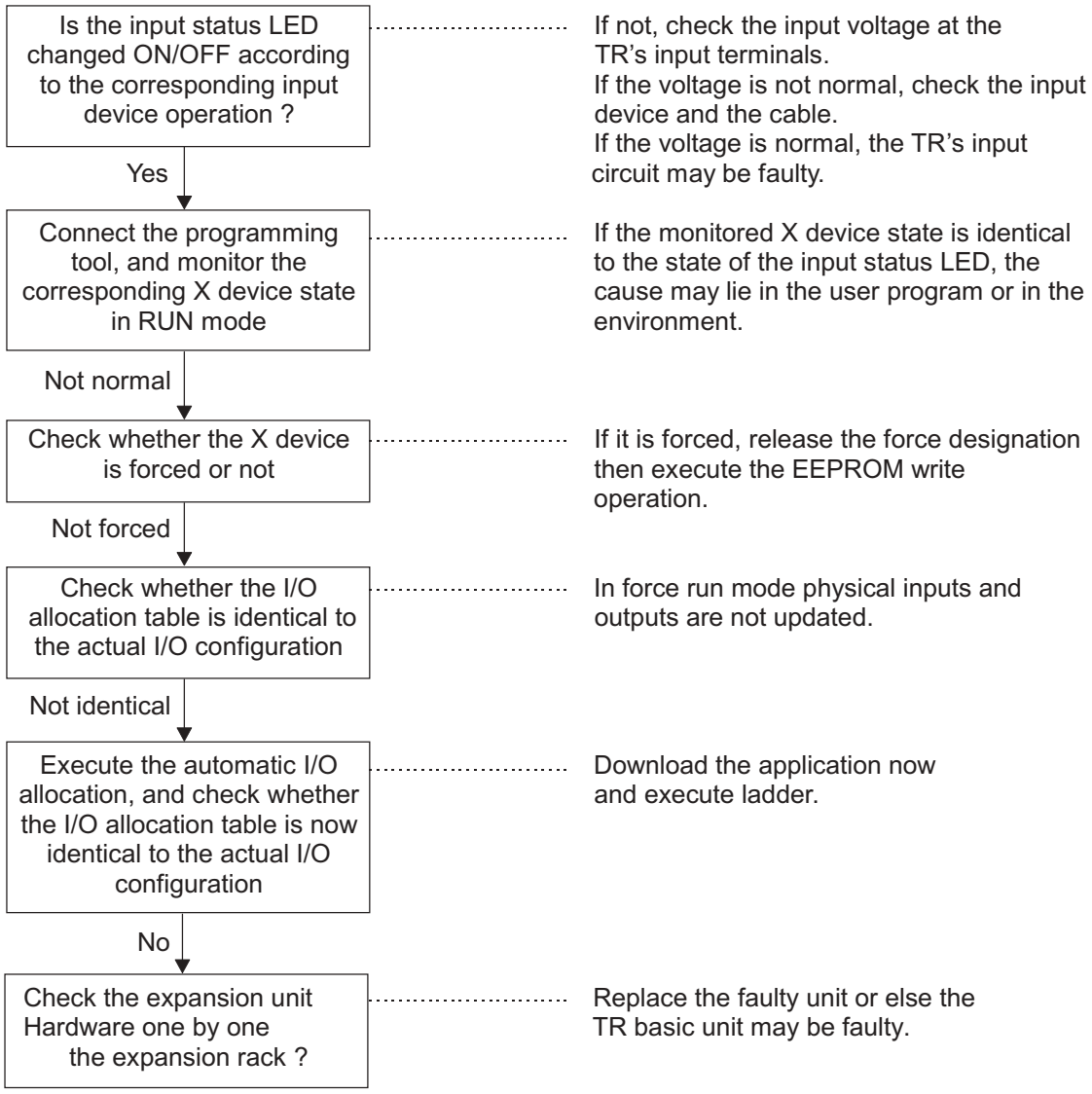
8.1.3 Program Check

Check the user program based on the following points if it is running but the operation does not work as intended.

1. Whether duplicated coils are not programmed.
2. Whether a coil device and a destination of a function instruction are not overlapping.
3. Whether the ON/OFF duration of an external input signal is not shorter than the unit's scan time.
4. Whether a register/device which is used in the main program is not operated erroneously in the interrupt program.

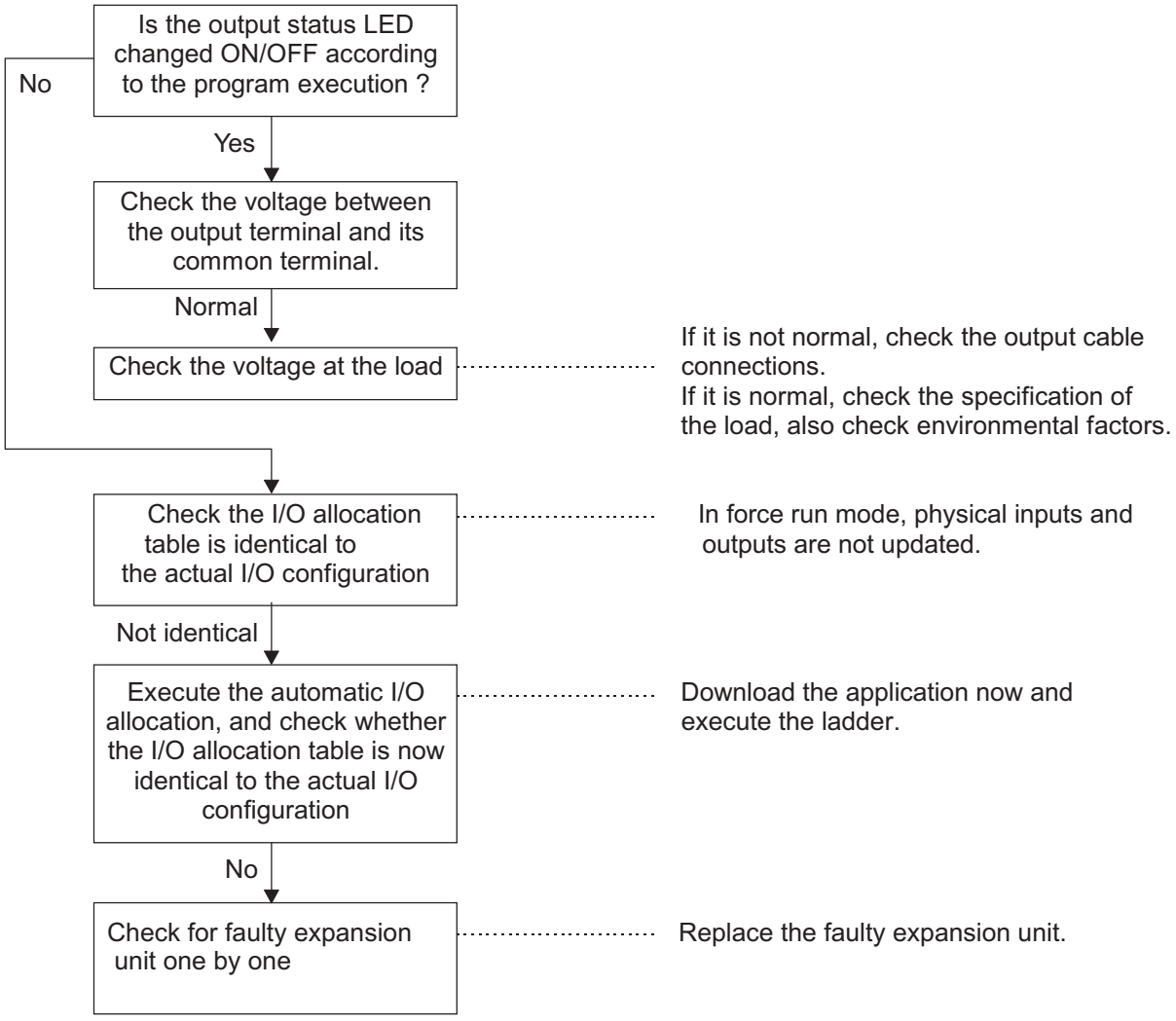
8.1.4 Input Check

If the program is running but the external input signal is not read normally, check the following points:



8.1.5 Output Check

If the output status monitored on the programming tool is normal but the external output device (load) is not operated normally, check the following points:



8.1.6 Environmental Problem

If the following improper operations occur in the controlled system, check possible environmental factors.

(1) If an improper operation occurs synchronously with the operation of I/O devices:
The noise generated at ON/OFF of the output device (load) may be the cause of the problem. Take necessary measures mentioned in section Precaution.

(2) If an improper operation occurs synchronously with the operation of surrounding equipment or high-frequency equipment:
The noise induced in I/O signal lines may be the cause of the problem. The surge voltage, voltage fluctuations, or differences of grounding potentials may cause the problem, depending on the power supply system or the grounding system. Check the operation in accordance with the precautions as maintioned. For some cases, isolation from the ground may lead to the stable operation.

(3) If an improper operation occurs synchronously with the operation of machinery:
The vibration of the equipment may cause the problem. Check that the installation status of the units and take necessary measures.

(4) If a similar failure is repeated after the unit is replaced:
Check that no metal debris or water drops has been entered into the unit/module. Apart from the above points, consider climatic conditions. If the ambient temperature is beyond the specified range, stable operation of the system is not guaranteed.

8.2 Self Diagnosis

ERROR Mode :-
The ERROR mode is a shut-down mode as a result of self-diagnosis. The PLC enters the ERROR mode if internal trouble is detected by self-diagnosis. In this mode, program execution is stopped and all outputs are switched off. The cause of the Error-down can be confirmed by connecting to TR PGM software. To exit from the ERROR mode, execute the Error Reset command from the TR PGM, or cycle power OFF and then ON again.

Self-Diagnosis :-
Checks the proper operation of the PLC itself. If an error has detected and cannot be recovered by re-tries, the PLF moves into ERROR mode.
Self-Diagnosis is performed in firmware at two stages:
A) At initialization (Power UP)
e.g. RAM, ROM check, IO mismatch check.
B) In continuous while loop
e.g. IO bcc check, scan time check.

If an error is detected by the self-diagnostic check of the PLC, the error messages and related information shown on the following pages will be recorded in the PLC event history table. If the error is severe and continuation of operation is not possible, the PLC turns OFF all outputs and stops the operation (ERROR mode).

The latest 30 error messages are stored in the event history table. This event history table can be displayed on the TR PGM. (Power ON/OFF is also registered) If the PLC has entered into ERROR mode, connect the TR PGM to the PLC to confirm the error message in the event history table. This information is important to recover from a trouble.

In the event history table, No.1 message indicates the latest event recorded. Each column shows the following information:

Date: The date when the error has detected
Time: The time when the error has detected
Event: Error message
Count: Number of times the error has detected by retry action
Info n: Related information to the error detected
Mode: PLC operation mode in which the error has detected (INIT. means the power-up initialization)
Down: Shows the PLC has entered into ERROR mode by the error detected

If the PLC is in the ERROR mode, operations to correct the program are not accepted.
In this case, execute the Error reset operation by the TR PGM to return the HALT mode before starting the correction operation.

Special devices and registers (M/MW):

Note :-
(1) These devices are set by the PLC operating system. These devices are read only for user.
(2) Devices marked as (down) are set in the ERROR mode. These type of errors will cause the PLC to enter in the Error mode.
(3) Devices marked as (alarm) are set when the corresponding condition has occurred. PLC continues to be in the same mode if these errors occurs.

The errors in the PLC can be categorized as below:

1. **CPU error**:
   a. System watchdog Reset (WDT Error)
   If there is error in this category the CPU error flag (MW01_0 device) sets along with corresponding device of the error. So for WDT error MW01_11 device sets.

2. **I/O Error**:
   a. I/O mismatch error
   b. I/O bcc error.
   If there is error in this category the I/O error flag (MW01_1 device) sets along with corresponding device of the error. So for I/O mismatch error MW01_13 device sets and for I/O bcc error MW01_15 device sets.

3. **Program Error**:
   a. Scan Time Over error
   If there is error in this category the I/O error flag (MW01_2 device) sets along with corresponding device of the error. So for Scan Time Over error MW02_1 device.

4. **Other Errors**:
   a. Clock calender error
   b. Retentive Data Loss error
   For Clock calender error MW01_5 device sets and for Retentive Data Loss error MW01_6 device sets

Above error conditions are checked either in each main loop scan or only at power up. This is mentioned in the following table.
The configuration devices (M) and configuration registers (MW) are used for special purposes.

Error Messages and related information:

No.	Event	Info1	Info 2	Info 3	Info 4	Special Device	Meaning and countermeasures	Check at
1	Retentive Data Loss Error					MW01_6	In the power-up initialization, data invalidity of RAM (back-up area) has been detected. If retentive registers are used, these validity are not guarant-eed. (No error down)	Only Power-Up
2	Clock-cal-endar error					MW01_5	The data of built-in calendar LSI is illegal.(No error down) Set the date and time.	Only Power-Up
4	I/O mismatch	slot No.	Unit Type			MW01_1 MW01_13	The I/O allocation information and the actual I/O configuration are not identical.(Error down) Check the I/O allocation and the option card mounting status	Only Power-Up
5	I/O BCC error		Unit No.	Register No.		MW01_1 MW01_15	I/O bus parity error has been detected in data read/write for I/O modules. An abnormality has been detected in I/O bus checking. (Error down)I/O No answer. (Error down) Check the expansion cable connect-ion and the I/O module mounting status.	Each main loop scan

No.	Event	Info1	Info 2	Info 3	Info 4	Special Device	Meaning and countermeasures	Check at
6	Scan time over	Scan time				MW01_2 MW02_1	The scan time has exceeded 200 mS (Default). (Alarm)Correct the program to reduce the scan time or use WDT instruction to extend the check time.	Each main loop scan
7	System power off						Power OFF (no error)	Only Power-Up
8	System power on						Power ON (no error)	Only Power-Up
9	WDT Error					MW01_00 MW01_11	The watchdog timer error has occurred.(Error down) If the error occurs frequently, replace the unit.	Only Power-Up

No	Device/register	Name	Function
1	MW01_0	CPU error (down)	ON at error state
2	MW01_1	I/O error (down)	ON at error state
3	MW01_2	Program error	ON at error state
4	MW01_5	Clock/calendar error(alarm)	ON when clock/calendar data is illegal
5	MW01_6	Retentive data loss/invalid(alarm)	ON when retentive data in RAM are invalid
6	MW01_11	System Watchdog error (down)	ON at error state
7	MW01_13	I/O mismatch (down)	ON at error state
8	MW01_15	I/O BCC error (down)	ON at error state
9	MW02_1	Scan time over (alarm)	ON when the scan time exceeds 200 ms

ROM Errors:

If the PLC does not have a program (Firmware / Application / Ladder) it remains in the wait loop as given in the Flow Chart. The Leds are used to indicates these conditions. These errors are not logged in the event history.

No	Condition	Indication
1	No Firmware or Firmware corrupted.	RUN LED and ERR LED blinks at one second interval simultaneously.
2	No Application or Application corrupted.	ERR LED blinks at one second interval.
3	No Ladder or Ladder corrupted.	ERR LED blinks at one second interval.

Diagnosis Registers for Serial and Ethernet Communication channels:

Following system registers and system coils can be used for the control and diagnosis of communication channels:

Register / Coil	Tag Name	Read / Write	Description
SW0003_14	COM1 Status	Read only	0 = Communication Error 1= Communicating with Master
SW0003_15	COM2 Status	Read only	0 = Communication Error 1= Communicating with Master
SW0003_13	COM3 Status	Read only	0 = Communication Error 1= Communicating with Master
SW0018	COM1 failed node reconnect time (Sec)	Read/write	Shows time in sec recover the communication with failed nodes for port1.the default value is 60Sec
SW0019	COM2 failed node reconnect time (Sec)	Read/write	Shows time in sec recover the communication with failed nodes for port1.the default value is 60Sec
SW0022	COM3 failed node reconnect time (Sec)	Read/Write	Shows time in sec recover the communication with failed nodes for port3.the default value is 60Sec
S0021	COM1 failed node reconnect control	Read/write	If this bit is set communication with the failed nodes is detected after scan time SW0018 for port1.By default : ON

Register / Coil	Tag Name	Read / Write	Description
S0022	COM2 failed node reconnect control	Read/write	If this bit is set communication with the failed nodes is detected after scan time SW0019 for port2.By default : ON
S0023	COM3 failed node reconnect control	Read/write	If this bit is set communication with the failed nodes is detected after scan time SW0022 for port3. By default : ON
SW64-SW65	Node Status Registers for COM1	Read only	Shows the status of the node, whether node is present or not. Total 2 word Register are mapped for 32 nodes.
SW80-SW81	Node Status Registers for COM2	Read only	Shows the status of the node, whether node is present or not. Total 2 word Register are mapped for 32 nodes.
SW96-SW111	Node Status Registers for COM3	Read only	Shows the status of the node, whether node is present or not. Total 16 word Register are mapped for 256 nodes.

MAINTENANCE AND CHECKS

In this chapter. . . .

- Precautions during operation
- Daily Checks
- Periodic checks
- Maintenanace Parts

9.1 Precautions during operation

When the TR's are in operation, you should pay attention to the following items:

(1) The programmer cable can be plugged or unplugged while the TR units are in operation. When you try to do it, do not touch the connector pins. This may cause malfunction of the TR units owing to static electricity.

(2) Do not plug nor unplug the expansion cable during power on. This can cause damage to the equipment. Furthermore, to avoid malfunction of the TR owing to static electricity, do not touch the cable ends.

(3) Do not touch any terminals while the TR unit is in operation, even if the terminals are not live parts. This may cause malfunction of the TR units owing to static electricity.

(4) Do not touch the expansion connector pins while the TR base model is in operation. This may cause malfunction of the units owing to static electricity.
Fix the expansion connector cover if the expansion connector is not used.

(5) Do not insert your finger into the option card slot while the TR unit is in operation. This may cause malfunction of the TR unit owing to static electricity.
Fix the option card slot cover securely.

(6) Do not insert your finger into the expansion rack's ventilation hole during power on. This may cause malfunction of the TR unit owing to static electricity.

9.2 Daily Checks

CAUTION

1. Pay special attention during the maintenance work to minimize the risk of electrical shock.
2. Turn off power immediately if the TR unit or related equipment is emitting smoke or odor. Operation under such situation can cause fire or electrical shock.

To maintain the system and to prevent troubles, check the following items on daily basis.

Item	Check		Corrective measures
Status LEDs	PWR (power)	Lit when internal 3.3 V is normal.	If the LEDs are not normal, see Troubleshooting.
	RUN	Lit when operating normally.	
	FLT (fault)	Not lit when operating normally.	
Mode control switch	Check that the mode control switch is in R (RUN) side. Normal operation is performed when this switch is in R (RUN) side.		Turn this switch to R (RUN) side.
Input LEDs	Lit when the corresponding input is ON.		■ Check that the input terminal screw is not loose. ■ Check that the input terminal block is not loose. ■ Check that the input voltage is within the specified range.
Output LEDs	Lit when the output is ON and the corresponding load should operate.		■ Check that the output terminal screw is not loose. ■ Check that the output terminal block is not loose. ■ Check that the output voltage is within the specified range.

9.3 Periodic Checks

CAUTION

1. Pay special attention during the maintenance work to minimize the risk of electrical shock.
2. Turn off power immediately if the TR unit or related equipment is emitting smoke or odor. Operation under such situation can cause fire or electrical shock.

Check the TR units are based on the following items every six months. Also perform checks when the operating environment is changed.

Item	Check	Criteria
Power supply	Measure the power voltage at the unit's power terminals.	85 - 132/170 - 264 Vac (AC PS) 20.4 - 28.8 Vdc (DC PS)
	Check that the terminal screw is not loose.	Not loose
	Check that the power cable is not damaged.	Not damaged
Installation condition	Check that the unit is installed securely.	Not loose, no play
	Check that the option card is inserted securely. (if any)	Not loose, no play
	Check that the expansion rack/unit is installed securely. (if any)	Not loose, no play
	Check that the expansion cable is connected securely and the cable is not damaged. (if any)	Not loose, not damaged
	Check that the I/O module on the expansion rack is inserted securely. (if any)	Not loose, no play
Input/output	Measure the input/output voltage at the unit's terminals.	The voltage must be within the specified range.
	Check the input status LEDs.	The LED must light normally.
	Check the output status LEDs.	The LED must light normally.
	Check that the terminal block is installed securely.	Not loose, no play
	Check that the terminal screw is not loose and the terminal has a sufficient distance to the next terminal.	Not loose, not contacting the next terminal
	Check that the each I/O wire is not damaged.	Not damaged
Environment	Check that the temperature, humidity, vibration, dust, etc. are within the specified range.	Must be within the range of general specification.

Item	Check	Criteria
Programming tool	Check that the functions of the programming tool are normal.	Monitoring and other operations are available.
	Check that the connector and cable are not damaged.	Not damaged
User program	Check that the T1/T1S program and the master program (saved on a floppy disk, etc.) are the same.	No compare error

9.4 Maintenance Parts

To recover from trouble quickly, it is recommended to keep the following spare parts:

Item	Quantity	Remarks
TR basic unit	1	Prepare at least one to minimize the down-time of the controlled system.
Programming tool	1	Useful for the troubleshooting procedure.
Master program	As required	Saved on a floppy disk, etc.
Expansion rack or unit (if any)	1	
I/O module (if any)	One of each type used	
Fuse for I/O module (if any)	One of each type used	

These spare parts should not be stored in high temperature and/or humidity locations.