Ultra-high Precision Ratio-metric Synchronous Controller
TRC-418T
(Super 416T)

User Manual

RATIO CONTROLLER

TENSION

○ RUN
○ PRG
○ ERR

TENSION SET

MODE ▲ ▼ SET
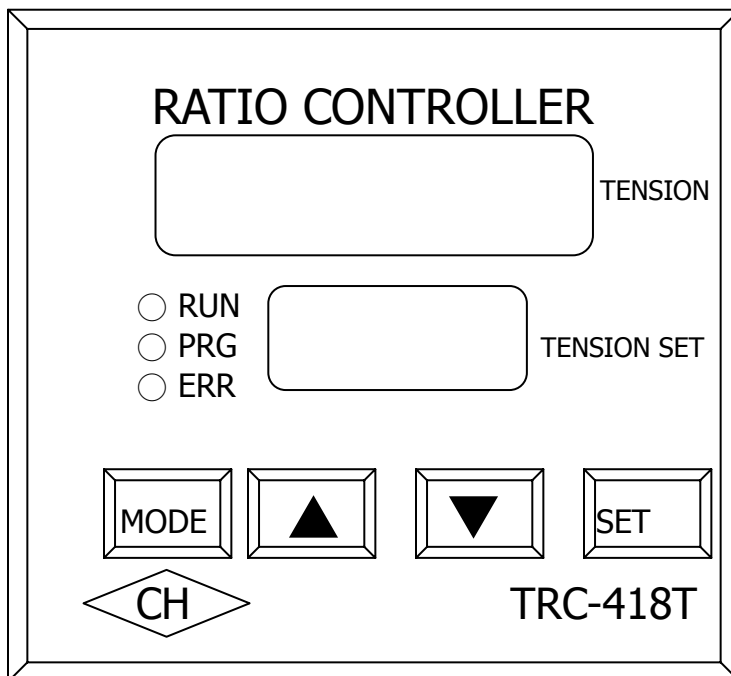
◇ CH ◇   TRC-418T

Thank you very much for using TRC-418T Ultra-high Precision Ratio-metric Synchronous Controller (TRC-418T). TRC-418T is an improvement on TRC-416T. It has been developed specifically to meet increasing customer demand for better control.

Before using TRC-418T, read the manual in order to find out wiring, parameter setting and handling of abnormalities of the device. Keep the manual for future reference.

▪ Attention:

(1) Do not wire TRC-418T or remove or install its connector when the power is on to avoid danger or damage to the device.

(2) Terminals 4-24 are all contacts of input/output signals. Do not connect them to AC power to avoid damage.

(3) Do not connect AC power and alien voltage to A/D and D/A input/output terminals 7-11.

(4) Do not remove the device's casing or conduct pressure tests on the parts of the device.

(5) The device's parameters have been set before shipping. If special control is needed, keep a record of the reset parameters.
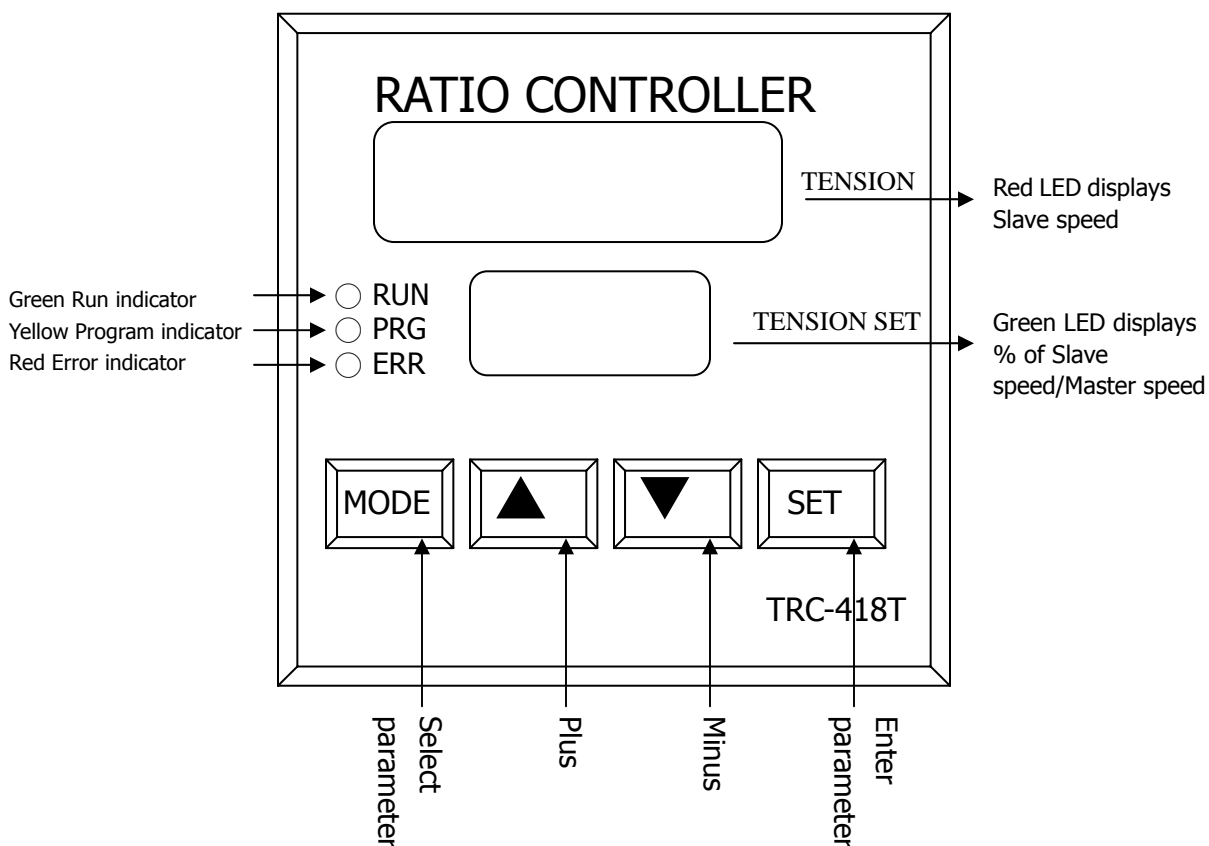
Contents

1. Features

(1) The device can work with inverters and DC drives and establish series/parallel connection with several motors. During synchronous operation, regardless of the speed, ultra-high precision ratio-metric control and position control can be achieved.

(2) Movement of several motors can be precisely synchronized. The specially designed signal tracking feature allows clear indication of slight change in speed during tests or while in use to facilitate selection of optimal parameter, hence operation of machinery and precision of design can be perfected.

(3) TRC-418T has a red LED and a green LED. The red LED displays Slave's speed difference E1/E2, A/D input and D/A output (Pr05), while the green LED displays the ratio-metric setting.

(4) TRC-418T has a built-in self-check feature, which checks for abnormalities to facilitate troubleshooting and diagnosis.

(5) Parameters can be adjusted in response to changes attributable to mechanical and production factors including adjustment of the machine's gear ratio, selection of the application's module, derivative/integral ratio, time it takes for the load to vary, etc.

(6) TRC-418 Thas a closed-loop design. It uses a encoder to input signal feedback of phases A and B in order to achieve precise ratio-metric synchronous control of several
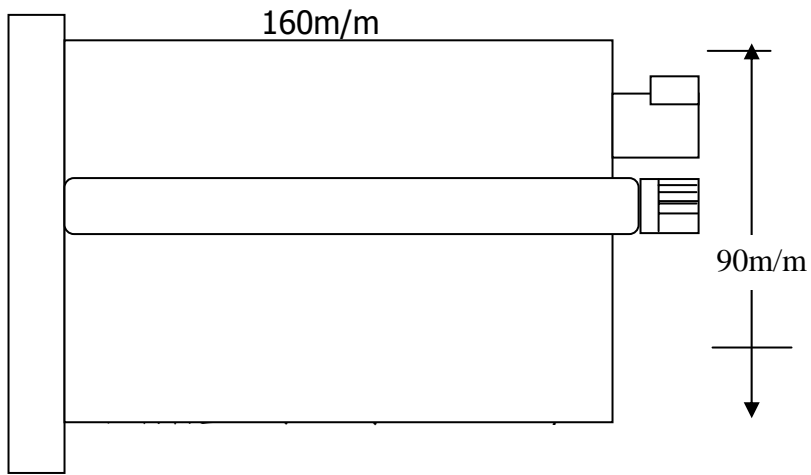
motors. In addition, the device is highly resistant to interference.

(7) TRC-418T simplifies its parameter design. All you have to do is enter the parameter, making using the device easier.

(8) The device automatically sets up the encoder's four dividing functions, which raises the encoder's resolution by four times.

2. Control panel

RATIO CONTROLLER

TENSION — Red LED displays Slave speed

○ RUN ← Green Run indicator
○ PRG ← Yellow Program indicator
○ ERR ← Red Error indicator

TENSION SET — Green LED displays % of Slave speed/Master speed

MODE ▲ ▼ SET

TRC-418T

Select parameter

Plus

Minus

Enter parameter

3. Dimensions

RATIO CONTROLLER

TENSION

○ RUN
○ PRG
○ ERR

TENSION SET

| MODE | ▲ | ▼ | SET |

◇ CH

TRC – 418T

100m/m (width)

100m/m (height)

160m/m

90m/m
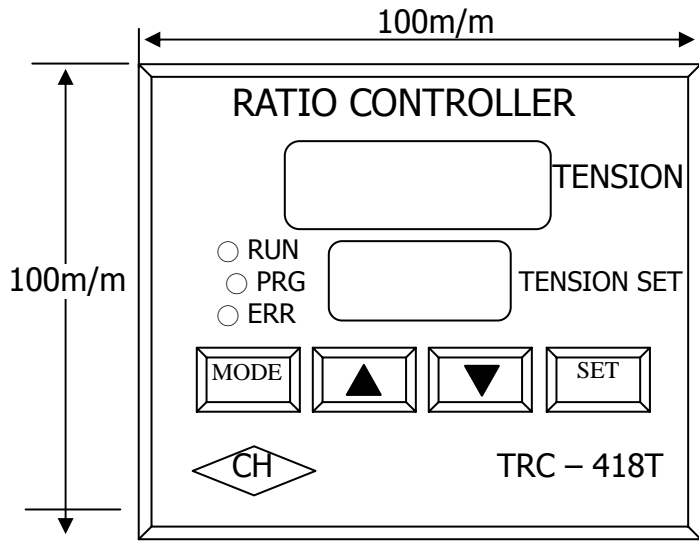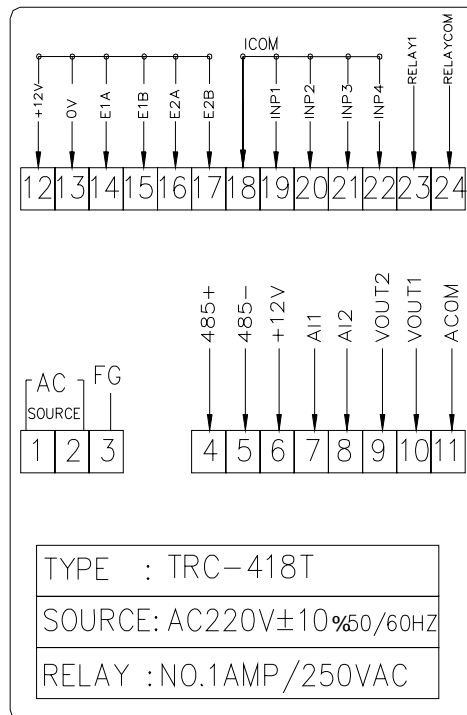
4. Wiring of control loop
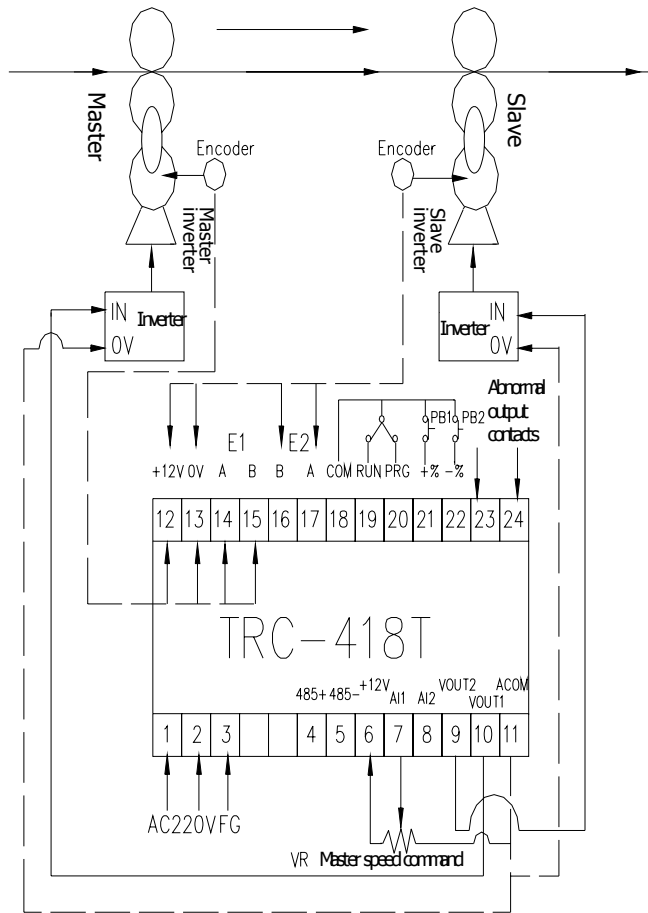
5. Wiring of terminals

6. Terminals:

Power　　　　　Terminals 1 and 2 are AC power input contacts.
　　　　　　　Specification: AC220V ±10%, 50/60HZ.
　　　　　　　Terminal 3 is the 3rd grounding.

Communication interface　　Terminals exclusively for
　　　　　　　communication.
　　　　　　　Terminal 4 is 485+.
　　　　　　　Terminal 5 is 485-.

A/D input   Terminals 6, 7, 8 and 11 are for A/D input, with the resolution being 2^{12} and input impedance 100KΩ. Terminal 7(+) is for master speed signal input. Correction of Terminal 8(+) Slave can be proportionally controlled, with the correction set via Pr18.
Terminal 6 is +12VDC.
Terminal 7 is for AI1 Master's signal input 0-10VDC.
Terminal 8 is for AI2 Slave's position change input.
Terminal 11 is ACOM analog signal COM contact.

D/A output   Terminals 9(+), 10(+) and 11(-) are for D/A output 0-10V to the inverter or DC controller. Use mesh wire shielded cord and separate it from the power cord. Do not place positive (+) and negative (-) reversely.
Terminal 9 is for VOUT2 Slave's D/A output 0-10VDC.
Terminal 10 is for VOUT1 Master's D/A output 0-10VDC.
Terminal 11 is ACOM analog signal COM contact.

E1 and E2   Terminals 12(+) and 13(-) are the encoder's power source DC12V ±3%, 100mA (MAX).

Encoder input   Terminals 14 and 15 are for Master encoder input signals.
Terminals 16 and 17 are for Slave encoder feedback signals.

Starting the device   Terminals 18 and 19 are for starting

the device, which switch to auto mode when the contacts short-circuit.

Setting the parameters   Terminals 18 and 20 are for setting the parameters. The parameters can be reset only when the contacts short-circuit. Refer to Page 10 for more information on the parameters.

Joggle mode   Terminals 18 and 21 are joggle acceleration A contacts.
Terminals 18 and 22 are joggle deceleration A contacts.
▪ They may be used to change the differential in Pr16.

Warning output   Terminals 23 and 24 are malfunction output A contacts. When E1 and E2 signals' cumulative differential reaches that set by Pr27, RELAY outputs. When the differential is smaller than the setting, RELAY returns to the non-output state, with the RELAY contact's capacity being 1A 250VAC.

7. Use of the differential

When the machines start, they run synchronously. When the operator feeds the cloth (the raw material), it stays slack. Press the key to short-circuit Terminals 18 and 21, which will accelerate Slave by 10% (the percentage can be set via Pr16). To loosen the cloth (the raw material), press keys 18 and 22 to short-circuit.

Master's line speed 10M/min   Slave's line speed

10M/min

Slack when fed

Master   Slave

18

Instantaneous
acceleration 21

Instantaneous
deceleration
22
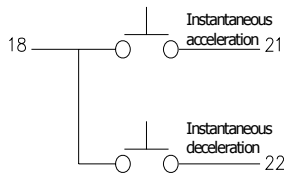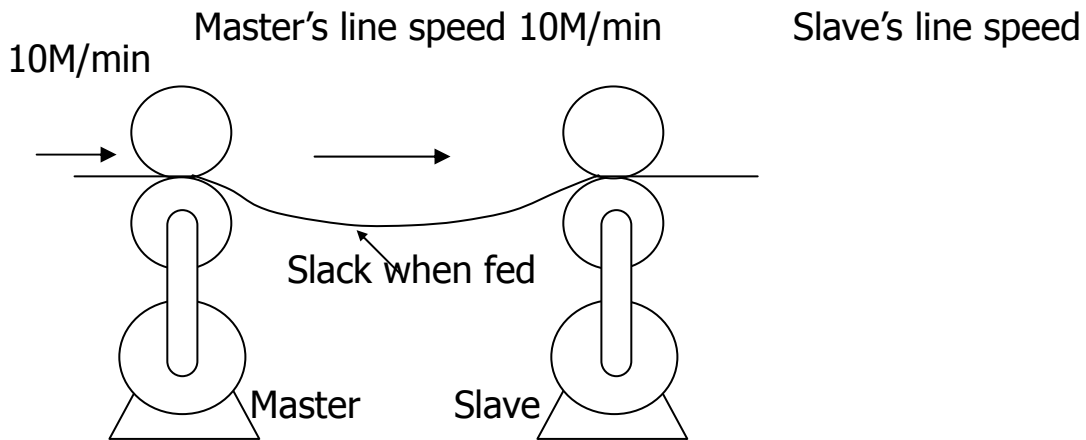
When Contacts 18 and 21 are connected, Slave can accelerate to 11m/min. The operator adjusts the speed until the cloth is no longer slack before releasing the differential push-button.

When Contacts 18 and 21 are connected, Slave can decelerate to 9m/min. The operator adjusts the speed until the cloth is no longer too tight before releasing the differential push-button.

Master   Slave
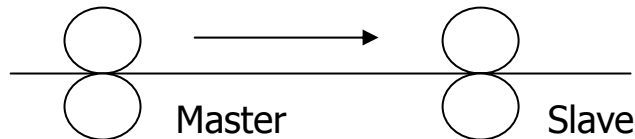
8. Setting parameters

Basic requirements: 1. Terminals 18 and 20 need to be short-circuited (Note).

2. Password: Parameter 1 needs to be set at 1000.
Note: If 18 and 20 are open, the parameter can be viewed, but not changed.

Steps: 1. Press MODE +SET, the control panel displays entry into Parameter 1.

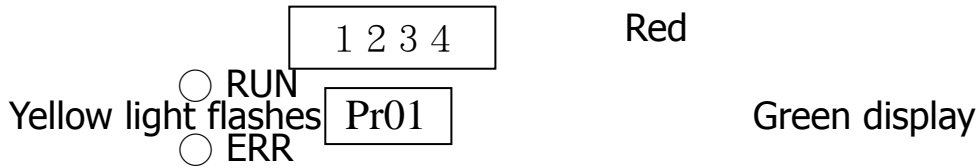| 1 2 3 4 |

Red

◯ RUN
Yellow light flashes | Pr01 | Green display
◯ ERR

2. Press SET, the control panel displays.

| 1 2 3 4 | Red letters

• PRG | Pr01 | Green letters flash
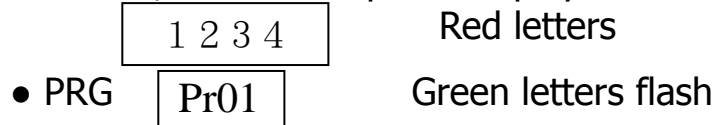
3. Press △ or ▽ to adjust the red LED number to 1000.

| 1 0 0 0 | Red LED

| Pr01 | Green LED flashes
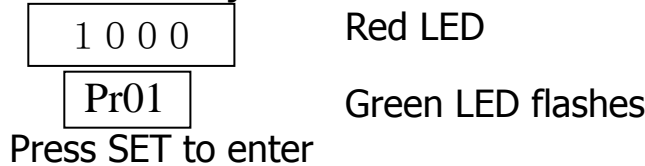
Press SET to enter

4. The control panel displays: Indicating entry into Parameter 2.

| 0 0 0 1 |

| Pr02 |
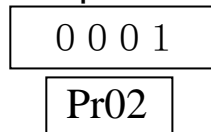
5. If Parameter 2 needs change, press SET to enter the change mode. Press △ or ▽ to select the function that needs change. Once the change is made, press SET to enter and the control panel switches to Parameter 3. Make a change to Parameter 3 in the same way as to Parameter 2.

6. If only Parameter 5 needs change, press △ to switch to

| 0 0 1 0 | Red LED

| Pr05 | Green LED

Press SET to enter the change mode. Once the change is made, press SET to enter.
Press MODE to return to operating mode.
For example, the following are the steps to take if Parameters 3 and 10

need change:

Press		To display
MODE+SET	1000	Red LED

○PRG | Pr01 | Green LED

↓

△ | 0001 |
| Pr02 |

↓

△ | 0001 |
| Pr03 |

↓

SET | 0001 |
| Pr03 | Flashes

↓

△or▽ | 0002 |
| Pr03 | Flashes

↓

SET | 1000 |
| Pr04 |

↓

△ | 1000 |
| Pr05 |
.   .
.   .
.   .

△ | 005.0 |
| Pr09 |

↓

△ | 00.50 |
| Pr10 |

↓

SET | 00.50 |
| Pr10 | Flashes

↓

△or▽ | 00.70 |
| Pr10 |

↓

SET | 0030 |

```
          ┌─────┐
          │ Pr11│
          └─────┘
│
↓         ┌─────┐
MODE      │0000 │  Standard control panel value set OK
          ├─────┤
          │1000 │
          └─────┘
```
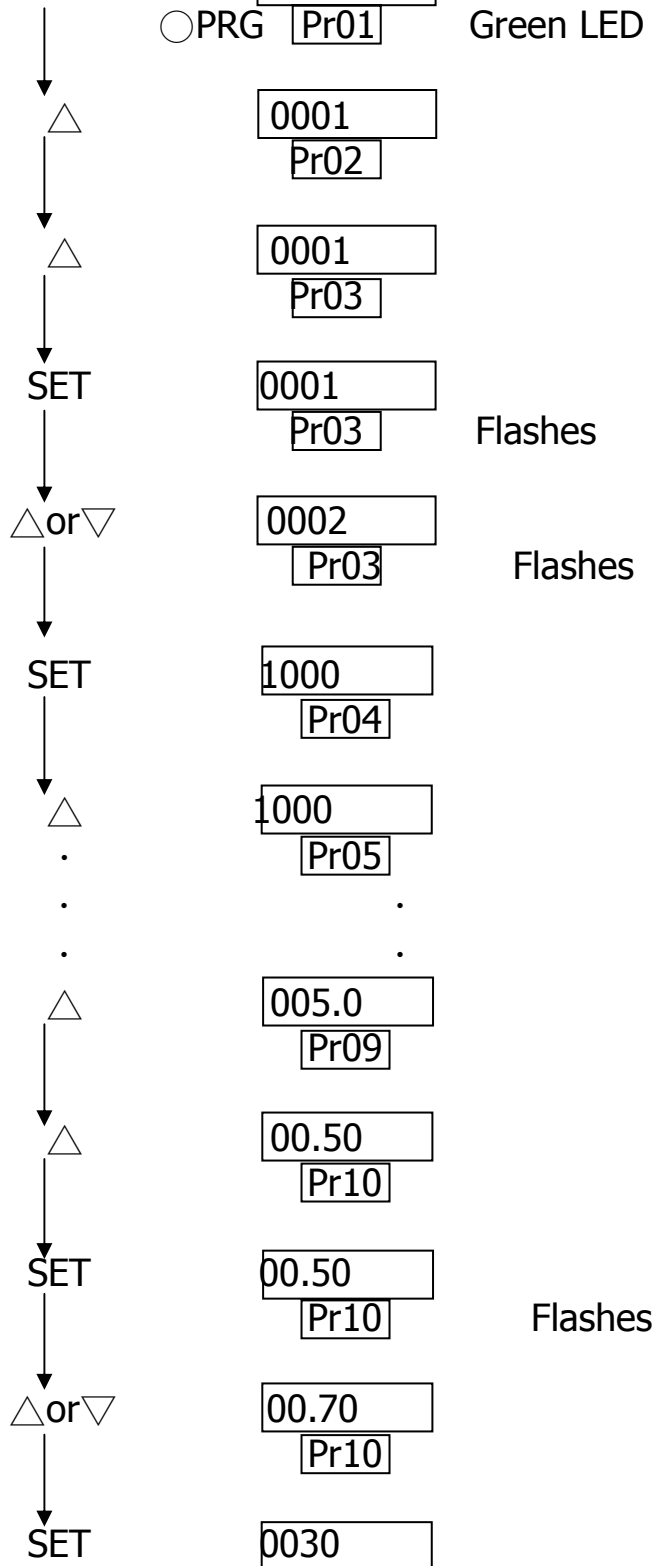
9. Table of parameters

Parameter	Name	Range	Factory setting	User setting
Pr01	Enter password	00000-99999	01000	
Pr02	P (%) Correction to sensitivity (The greater the value, the faster the reaction) 1-20	00001 - 00020	00005	
Pr03	I (Integral) Correction to sensitivity (The smaller the value, the faster the reaction) 1-21	00001 - 00021	00012	
Pr04	Reserved	00000-00005	00000	
Pr05	Display method: 0: Line speed 1: Angle (E1-E2) 2: Output voltage 3: ADC input voltage	00000-00003	00001	
Pr06	A/D acceleration time	0000.1-0100.0 (sec)	00010.0	
Pr07	A/D deceleration time	0000.1-0100.0 (sec)	00010.0	
Pr08	Ratio correction numerator K	00001-65535	00001	
Pr09	Ratio correction denominator K	00001-65535	00001	
Pr10	Master speed output K	00001-09999	01000	
Pr11	Line speed correction K	00001-09999	01000	

Pr12	Operating mode: 1: Speed tracking 2: Angle tracking	00001-00002	00002	

Pr13	Source of speed command:
	0: Unused (Use ENCODER only)
	1: A/D input master speed
	  +Slave mode
	2: A/D input master speed
	  +Master mode
	3: A/D input master speed
	  +open loop handling
		00000-00003	00002	

Pr14	ENCODER number per revolution (x10)	00000-00100	00060 (600P/R)	
Pr15	The motor's highest RPM (x100)	00001-00050	00018 (1800)	
Pr16	Plus/minus joggle percentage Note 1	00000-01000	00080 (8.0%)	
Pr17	A/D master speed correction K/ Max A/D ratio correction	00000-99999	01000	
Pr18	Position of upper row decimal point	00000-00003	00000	
Pr19	Position of lower row decimal point	00000-00004	00000	
Pr20	Master ENCODER inverse setting 0: Normal 1: Inverse	00000-00001	00001	
Pr21	Slave ENCODER inverse setting 0: Normal 1: Inverse	00000-00001	00000	
Pr22	Upper limit in ratio setting	00000-65279	19999	
Pr23	Lower limit in ratio setting	00000-65279	05000	

Pr24	Locking of ratio setting key on control panel 0: Unlock 1: Lock	00000-00001	00000	
Pr25	MODBUS communication address	00001-000255	00001	
Pr26	MODBUS communication speed	00001-00005	00004	
Pr27	ERR1 setting (P/R)	00001-99999	01000	
Pr28	error correction delay time	**00000~00255**	**00000**	
Pr29	Tension supposes the fixed point	**00000~99999**	**00500**	
Pr30	Tension feel the belt	**00000~99999**	**00000**	
Pr31	Integral time	**00000~00255**	**000.00**	
Pr32	Tension **P GAIN**	**00000~99999**	**00000**	

Press SET to return ERR light and ALARM contact.

Method used to enter the parameter: MODE + SET

Press ▲ to select the parameter.

Press SET to change the parameter.

Note 1: When Pr16 is set at 0, the function of Contacts 21(+%) and 22 (-%) is changed to Contacts 21(+) and 22(-) control panel setting function.

10. Description of parameters

Pr01   Password: The password should be set at 1000. If it isn't 1000, press △ or ▽ to change it to 1000 before pressing SET.

Pr02   Adjusting reaction sensitivity (P): The range is between 1 and 20, with 1 being the least sensitive and 20 the most sensitive. When tracking the position, it has to be set in conjunction with Pr031.

Pr03   Setting position tracking sensitivity (I): The range is between 1 and 21, with 21 being the least sensitive and 1 the most sensitive. If Pr10 is set to track the speed, the parameter is not used.

Pr04   The parameter is reserved.

Pr05   Selecting what the red LED displays:
0: Speed
1: E1-E2. Switch to 1 during trial run. Adjust Pr02 and Pr03 depending on E1-E2 in order to facilitate control.
2: D/A output voltage: Displaying the voltages of Terminals 9(+) and 11(-) of Slave Vout2. It can be used to check whether D/A malfunctions.
3: A/D input voltage: Displaying the input voltages of Terminal 7(+) and 11(-) of AI1. It can be used to check whether A/D malfunctions; (displayed value/4096) x10VDC=AI1 voltage.

Pr06   A/D acceleration time: The range is 0.1-100.0 sec. The parameter is for setting the acceleration time of Master inverter between 0.1 and 100.0 sec.

Pr07   A/D input deceleration time: The range is 0.1-100.0 sec. The parameter is set in the same way as Pr06.

Pr08   Ratio correction numerator needs to work in conjunction with Pr10 setting.
For example: Ratio correction is 0.5=1(Pr08)/2(Pr09)
        Ratio correction is 0.995=995(Pr08)/1000(Pr09)
Setting ratio correction K: Range 0.001-9.999 times. This is a different correction coefficient specifically for correcting the machine's deceleration ratio and wheel diameter. According to the device's calculation, the actual E1/E2 ratio is the ratio X set by the control panel correcting K.

Pr09   Ratio correction denominator: Refer to Pr09 for description.

Pr10   A/D input correction K: The range is 0.001-9.999.

Formula: A/D input × K → CPU master controller

Pr11   Speed display correction K: The range is 0.001-9.999. The
        parameter is used when Pr05 is set at 0. After being rounded
        to the nearest thousandth, the quotient obtained after
        dividing actual speed by displayed speed is entered.

$$\frac{\text{Actual speed}}{\text{Displayed speed}} = X.XXX \cdots$$

Pr12   Operating mode:
        0: Tracking speed only
        1: Tracking position throughout

Pr13   The determined by fate source of the speed is established :
        0: Leave main speed signal source on AI1 (use ENCODER is
           it input to make mathematical calculations only)
        1: AI1 is consulted in the main speed signal, and use
           ENCODER and make mathematical calculations
           introduction .
        2: AI1 as main speed signal source , use ENCODER is it
           input for complement to make mathematical calculations.
        3: AI1 is looked on as the main speed signal source, do not
           use ENCODER to make mathematical calculations , make
           and open the return circuit , Make mathematical
           calculations.

Pr14   Tracking the encoder's PPR input (divided by 10): When using
        a 200-PPR encoder, enter 20. When using a   600-PPR
        encoder, enter 60.

Pr15   Setting the RPM (divided by 100) when Slave runs at top
        speed: If a 4P motor and the inverter's top frequency is 90Hz,
        rpm≒2700, set the parameter at 27. If a 6P motor and the
        inverter's top speed is 60Hz, rpm≒1200, set the parameter at
        12.

Pr16   Setting the differential's ratio: The range is 0.1-100.0%. Refer
        to Page 9 for use of the differential. When Pr16 is set at 0, the
        function of Contacts 21(+%) and 22 (-%) is changed to

Contacts 21(+) and 22(-) control panel setting function.

Pr17   A/D input correction voltage: ±0.0-2.55VDC is the result calculated by the encoder used to correct A/D voltage range. That is, D/A output = A/D input × K ± Pr17.

Pr18   Position of red LED's decimal point:
      0: 0000.
      1: 000.0
      2: 00.00
      3: 0.000

Pr19   Position of green LED's decimal point:
      0: 00000.
      1: 0000.0
      2: 000.00
      3: 00.000
      4: 0.0000

Pr20   Master inputting encoder phase: 0: Positive, 1: Negative. After turning on the device, Master's phase may be incorrect as its encoder turns to a different direction. In this case, the device displays Err 02 and the parameter needs change.

Pr21   Slave encoder's phase: 0: Positive, 1: Negative. After turning on the device, if the phase of Slave's encoder is incorrect, the device displays Err 04 and the parameter needs change.

Pr22   Upper limit in ratio setting: The range is 0.0001-6.5279. If the upper limit is set at 2.0000, the ratio on the control panel can only be set at a maximum of 2.0000.

Pr23   Lower limit in ratio setting: The range is 0.0001-6.5279. If the lower limit is set at 0.5000, the ratio on the control panel can only be set at a minimum of 0.5000.

Pr24   Locking of the ratio setting on the control panel:

0: Not applicable

1: The setting on the control panel is locked. The ratio setting cannot be changed.

Pr25   MODBUS communication address: MODBUS communication requires designation of every node's position. It cannot be repeated in the same loop. The range is 001-255.

Pr26   For communication, a uniform rate can be set as follows:
1 = 2400
2 = 4800
3 = 9600
4 = 19200
5 = 38400

Pr27   Setting E1-E2 discrepancy: The range is 1-9999P/R. If E1-E2 discrepancy is greater than or the same as the preset value, RELAY outputs. The feature works as a protection. The preset value should be at least 500. The error code is ERR1.

Pr28   is when the start the error correction delay time, the unit is 0.1 second.

Pr29   **to set the** tension revision supposes the fixed point.

Pr30   is the tension does not feel the belt, if supposes the definite value is 3, then expressed Pr05 ±3 for does not feel the belt.

Pr31   is the tension 1st section of I value corrected speed K value, this parameter for the tension calculation corrected speed, a hypothesis bigger tension correction value is quicker. Unit 0.01 second.

Pr32   is the tension P value, correction value the K value, is the dislodgement picks out instantaneous correction value, the numeral recovers the overhaul correction value to be bigger.

11. Matters needing attention during trial run

1. Make sure the wiring is correct.
   1. Is the power AC220V±10% and input into contacts of Terminals 1 and 2?
   2. Are output signals of Phases A and B of Master encoder (E1) connected to the device's contacts of Terminals 14 and 15?
   3. Are output signals of Phases A and B of Slave's encoder (E2) connected to the device's contacts of Terminals 16 and 17?
      - Connect the wire mesh of Master (Slave) encoder to the device's Terminal 13.
   4. During synchronous operation, Terminals 18 and 19 need to be shorted.
   5. If an internal parameter needs change, Terminals 18 and 20 need to be shorted.
   6. D/A output of the device's Terminals 10(+) and 11(-) needs to connect to the analog frequency command contact of Master inverter.
   7. D/A output of the device's Terminal 9(+) and 11(-) needs to connect to the analog frequency command contact of Slave's inverter.

2. Acceleration/deceleration time of Master drive needs to be set at less than 0.5 second, with the optimal time being 0.3 second.

3. Set Slave inverter's acceleration/deceleration time at less than 0.5 second, with the optimal time being 0.3 second.
   - Contact the manufacturer if the acceleration/deceleration time needs to be at least 1 second.

4. Slave inverter is best started at 0.1Hz.

5. The cord for the device's D/A output to the inverter needs to be shielded and separated from the power cord. Connect wire mesh to the 0V contact where inverter signals are input.

6. Troubleshooting

Condition: Pr5 is set at 1, Pr12 2 and Pr13 2.
   1. Normal.
   2. Master starts, Slave does not.
     Cause: (1) START contact (Terminals 18 and 19) not shorted.
             (2) The ratio is set at 00000 or the ratio K is 00000.
             (3) Inverse master encoder E1 input phase.
             ▪ In case of inverse master encoder phase, the device
               displays Err 2.
             (4) Master encoder E1 signal is not input into the device's
               contacts of Terminals 11 and 12. The RUN light flashes.
             (5) D/A output points 9(+) and 11(-) are wrongly
               connected or D/A malfunctions.

   3. Master starts; Slave runs at full speed.
     Cause: (1) Inverse A and B phases input into Slave encoder E2.
               If Slave is inversely connected, the device displays Err 4.
             (2) Slave encoder E2 input circuit is wrongly connected or
                 E2 malfunctions.
             (3) D/A malfunctions, outputting DC 10V in full.
             (4) The ratio setting is too high.

   4. Slave motor's speed is unstable.
         Change Pr12 to 0 and try again. If it turns out normal, it means
Slave's torque is not enough to overcome the inertia. Adjust Pr02 and
Pr03 and try again. If it fails, it means position tracking mode cannot
be used, or master A/D input needs to be accepted.

If problem persists, contact the manufacturer.

12. Malfunctions and troubleshooting

Red LED	Green LED	ERR light	RUN light	Abnormalities/causes	Solutions
0000	Preset value		Flashes	Slave speed is zero; E1 signal is not input.	Check E1 encoder and axle connector to see if they malfunction, and check signal cable to see if it is problematic.

Has a number		Lit		Slave speed is zero; E1/E2 signal cables are inversely connected.	E1/E2 signal cables trade places.
Has a number	Err. 2			Master speed is zero; E1 signal cable's A and B phases are wrongly connected.	E1 signal cable's A and B phases trade places or change Pr20.
Has a number	Err. 4			Slave runs at full speed; E2 signal cable's A and B phases are wrongly connected.	E2 signal cable's A and B phases trade places or change Pr21.
		Lit		Slave runs at full speed.	1. The ratio is wrongly set (The ratio is set too high.) 2. Check encoder E2 to see if it malfunctions. 3. Are the wires wrongly connected? 4. The controller D/A malfunctions.
		Lit		Slave speed is zero; D/A output to inverter circuit is problematic or the inverter is abnormal.	Check to see whether D/A signal cable to the inverter is normal, and whether the inverter is down or abnormal.
				Slave speed is unstable.	1. The device calculates faster than the inverter can catch up. Lower the values of Pr02 and Pr03. 2. Inverter acceleration/deceleration time improperly set. Set the time at 0.3 sec. 3. Insufficient motor torque (increase horsepower).
				The ratio has been adjusted to synchronize the machines and then	1. The inverter and motor axle center skid. Check their positions and the axle connector.

				changed.	2. The encoder's signals are omitted. Check to see if single turn signals and specs are omitted.

Malfunctions and troubleshooting

To decide whether the device is problematic, find out what its normal conditions are like as outlined below:
1. After powering on, the LED display on the device's control panel has to light up. If no number is displayed, find out whether the device's Terminals 1 and 2 are connected to a 220VAC power source. If yes, it means the device's power supply system is out of order and needs to be replaced.

2. When requesting the device to work, Terminals 18 and 19 need to be shorted. After Terminals 18 and 19 are shorted, the device either begins working or stands by. There are LED lights on the left of the control panel. The RUN light may be used to decide which one of the following three states the device is in:
   1. Terminals 18 and 19 are open. RUN light is not lit.
   2. Terminals 18 and 19 are shorted. RUN light is lit.
      The device is standing by: RUN light flashes.
      The device is working: RUN light is lit. As long as the device correctly receives the phases of Master E1 encoder, the light needs to be lit. If it still flashes, it means the signals of Master encoder have not reached the device's Terminals 14 and 15. The wires need to be checked.

3. Method in which the device enters its internal parameter mode:
   1. Short Terminals 18 and 20.
   2. Press MODE+SET to enter internal parameter mode.
   The user can enter internal parameter mode to change data when the device is working. Press MODE to exit parameter mode and return to work mode.

4. Green LED displays error codes, with the ALM light lit.
   ERR01: E1-E2 is the same as or greater than Pr27, ALM is lit.

ERR02: Master encoder malfunctions or in the case of inverse phases of the encoder, ALM is lit.

ERR04: Slave encoder malfunctions or in the case of inverse phases of the encoder, ALM is lit.

ERR03=ERR01+ERR02

ERR05=ERR01+ERR04

So on and so forth.   END