ALTEC®

TENSION CONTROLLER
TC950

INSTRUCTION MANUAL

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1 Introduction

The TC950 Tension Controller is an application-specific controller designed to provide you with precise control over winding and unwinding tension control applications for web and strand.

The tension controllers can be divided into manual, half-automatic and full automatic controller. According to the different needs of customers, the TC950 tension controller can be configured as manual, half-automatic or full-automatic tension controller.

For manual tension controller, the operator adjusts the actuation current of the powder clutch/brake manually to get the desired tension control.

The half-automatic tension controller also known as diameter or opened-loop tension controller, the tension controller calculates the reel radius automatically during winding or unwinding process, according to the current reel radius and setting tension, the tension controller adjusts the output to get the constant tension controls.

The full automatic tension controllers detect the web tension with tension sensor directly. According to the difference between setting tension and measured tension and the build-in PID algorithm, the controller adjusts the output automatically to get the precision constant tension control of the web.

2 Features

- Full digital circuits, easy tension calibration.
- Speed synchronous tracking function, speed signal input range: 0~10V.
- Various optional outputs for different applications.
- Advanced PID control algorithm provides high control precision.
- RS485/RS232 serial communications.
- Measured Tension transmission.
- Automatic/Manual tension control.
- Reel exchange function.
- Wide range switching power supply (85~264V).
- Friendly user interface, easy to use.
- More cost efficient.

3 Order Code

Model Number	-	Output	Comms	Comments
TC950	-			Automatic Tension Controller
		A420		4~20 mA
		V10		0~10 V
		V05		0~5 V
		PWM		Pulse Width Modulation
		Y1		Phase-shifting signal
			0	None
			RS232	RS232
			RS485	RS485
			BS	Measured tension(PV) transmission

Model code examples:
TC950-A420-0:TC950 with 4~20mA outputs.
TC950-V10-0: TC950 with 0~10V outputs.

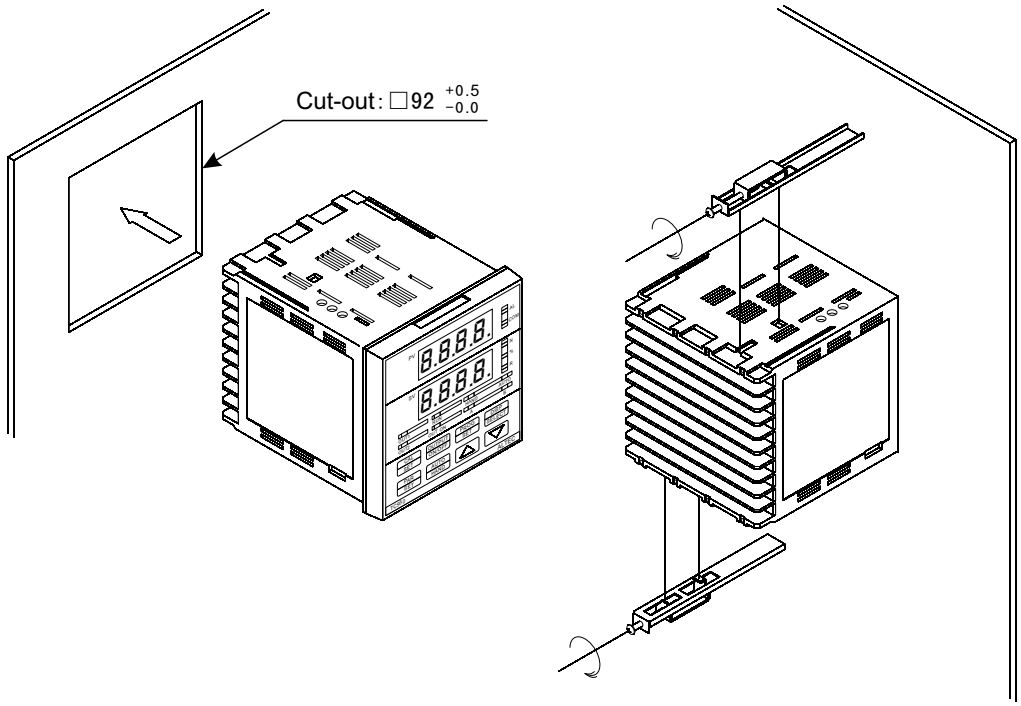
Note:
For phase-shifting output, please specify the frequency of the power supply if it is not 50 Hz.

4 Installation

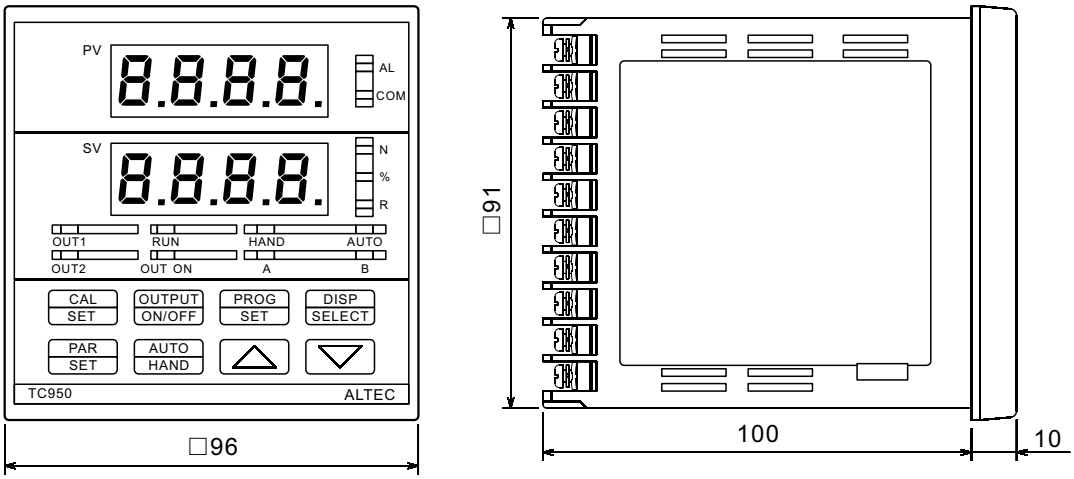
1). Prepare a square cut-out on the mounting panel to the size shown below.

2). Insert the controller through the cut-out.

3). Catch the mounting bracket to the holes top and bottom of the case, and screw to fix.



Dimensions



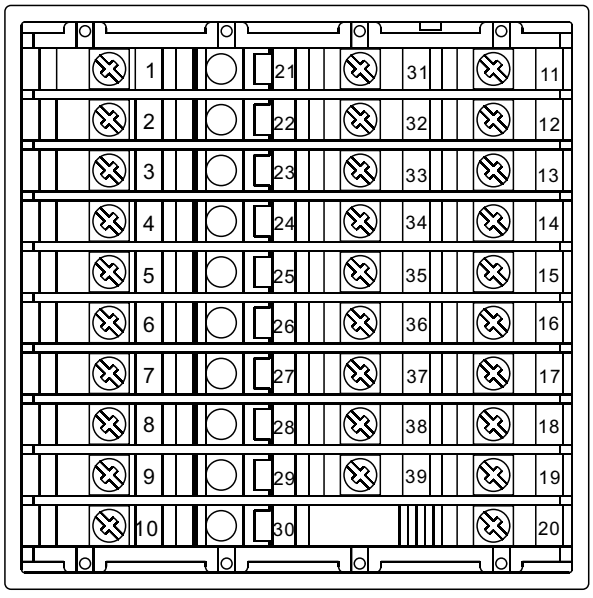
5 Electrical Wiring

Notice

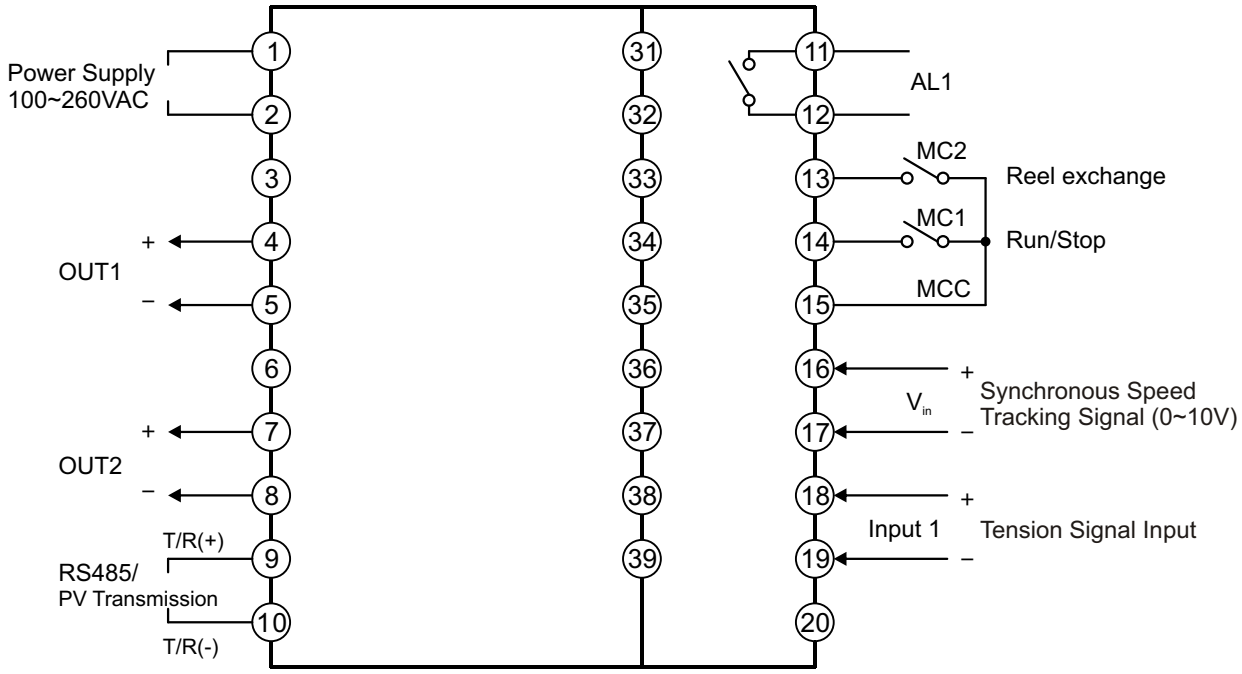
● In order to avoid electrical noise to the input signal, the signal line should be seqarated from the power line.

● If the AC power supply is connected to the I/O terminals or DC supply terminals, the tension controller will be burn out.

5.1 Rear Terminals Layout

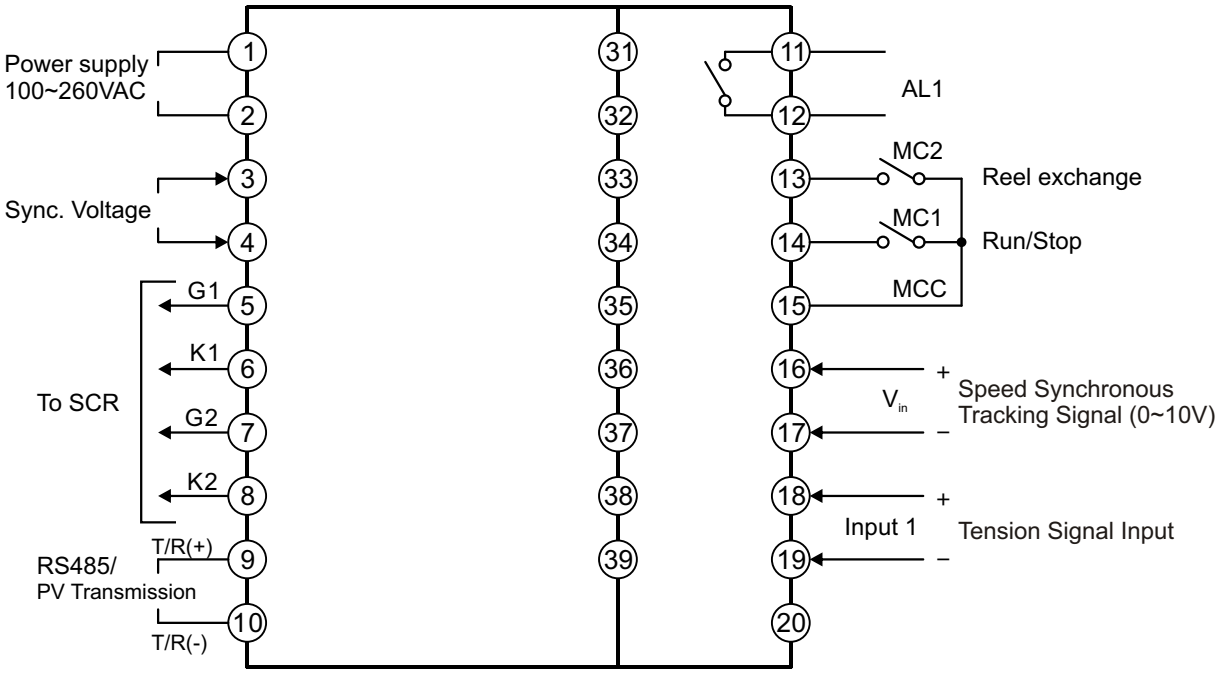


5.2 Wiring Diagram

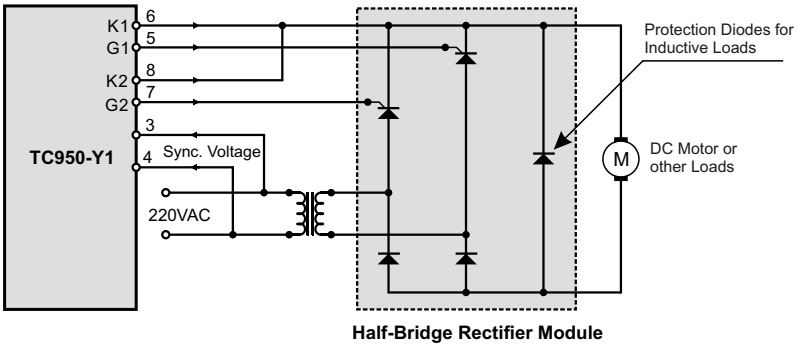


1) OUT1 and OUT2 can be configured as 0~20mA or 4~20mA, max load capacity: 750Ω.
2) Alarm relay (AL1) contact rating: 3A/250VAC.
3) The wire connected to terminal 13, 14 and 15 must be shield cable and far away from the power/load line otherwise the electrical noise may damage the controller.

5.3 TC950-Y1 Wiring (Drive SCR)



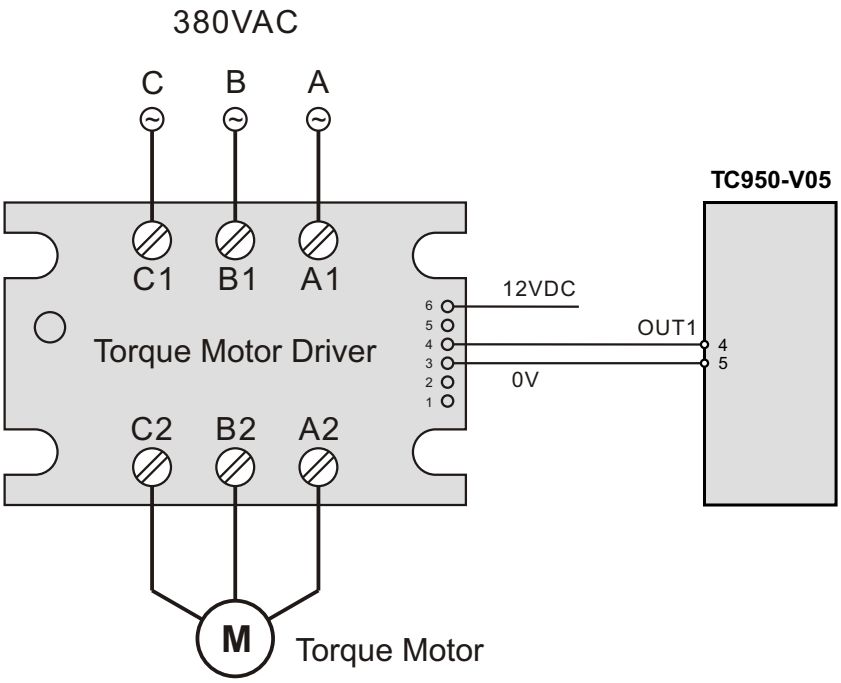
5.3.1 Half-Bridge Rectifier Connection



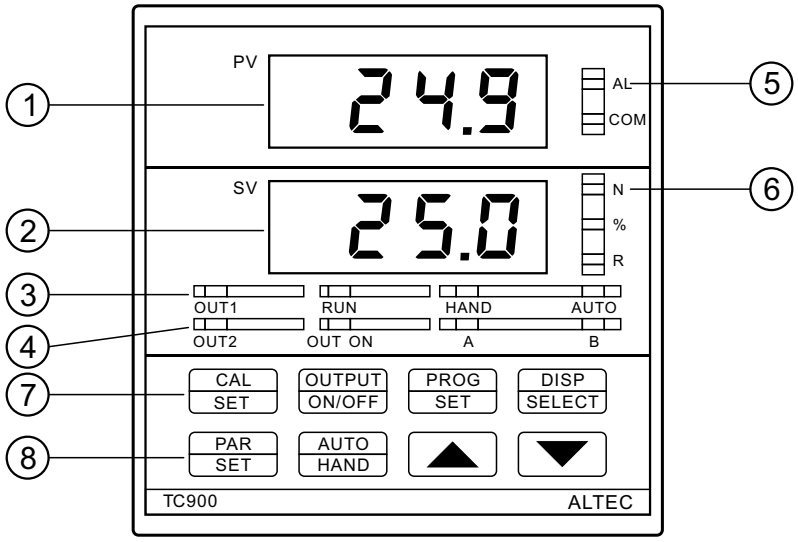
5.4 Tri-Phase Torque Motor Driver Connection (TC950-V05)

The TC950 tension controller can output a signal of 0~5V. The signal can be applied to the tri-phase torque motor driver (model: AL33) to drive the torque motor directly. This driving system is simple, reliable, etc..., idea for various high precision tension control systems.

Several models are available for AL33 series torque motor driver, please specify the motor's power or current while ordering.



6 Operator Interface



SN	Item	Description
①	PV Display	Indicates the Process Value, Parameter display
②	SV Display	Indicates the Setting Value, parameter value, output power
③	OUT1	Output 1 indicator
	RUN	Run indicator, lit when the Run/Stop switch(MC1-MCC) is 'ON'
	HAND	Manual mode indicator
	AUTO	Automatic mode indicator
④	OUT2	Output 2 indicator
	OUT ON	Output ON/OFF LED lit when output is 'ON'
	A	Reel A running indicator
	B	Reel B running indicator
⑤	AL	Alarm indicator
	COM	Communication indicator

SN	Item	Description
⑥	N	Tension SV displaying LED
	%	Output power displaying LED
	R	Sync. speed displaying LED
⑦	OUTPUT / ON/OFF	Output ON/OFF switch
	PROG / SET	Programming key
	DISP / SELECT	Lower display selector
⑧	PAR / SET	Parameter scroll key
	AUTO / HAND	Automatic/Manual mode switching key
	▲	Raise key, increase value
	▼	Lower key, decrease value

7 Operation

7.1 Display & Basic Operation

There are two LED displays indicate the operating parameters.
The upper display(green) indicates the measured tension value(PV) when in base condition. On modifying a parameter, the appropriate parameter appears.

The Lower display(red) indicates the setting tension value(SV) in the automatic mode. On modifying a parameter, the appropriate parameter value appears here. This display also indicates the output power in some case.

When the controller is powered on, the upper display indicates the model code of the controller, and the lower display indicates the software version.

3 seconds later, the upper display will indicates the measured tension(PV) while the lower display will indicates the setting tension(SV).

The type of contents displayed on the lower display is changed every time the 'Lower display selector' key is pressed. The type of contents displayed is indicated by the LED provided on the right side of the lower display.

Press the AUTO/HAND key, the automatic operation mode and manual operation mode can be changed conveniently.

When TC950 performs automatic operation, indicator '**AUTO**' will be lit, if the setting tension is displaying on the lower display(at this time, LED '**N**' is lit) press keys ▲ and ▼ to modify the setting tension. Adjustable range: SP H~SP L.

When the controller performs manual operation, indicator '**HAND**' will be lit, if output power is displaying on the lower display(at this time, LED '**%**' is lit) the control output power can be modified by pressing ▲ and ▼ key.

Control output can be turned ON or OFF by pressing 'OUTPUT ON/OFF' key. When indicator '**OUT ON**' is lit, output is 'ON' otherwise output is 'OFF', the output value becomes 0.

In automatic operation mode and when MC1 switch is turned on, indicator '**RUN**' will be lit; when MC1 switch is turned off, indicator '**RUN**' will be off.

When '**Synchronous Run/Stop**' function is available(SYnt = YES), and the Run/Stop switch is turned on.

When V_{IN} > RL.n, system starts, indicator 'RUN' will be lit.
When V_{IN} < RL.n, system stops, indicator 'RUN' will flash.

Run/Stop doesn't act in reel exchange progress.

The green LEDs '**OUT1**' and '**OUT2**' indicate the current control output level, higher the output power level, brighter the LED. The LED will be turned off when the output becomes 0.

LED indicator '**A**' indicates the output status of Reel-A, it is lit when Reel-A output is ON.
LED indicator '**B**' indicates the output status of Reel-B, it is lit when Reel-B output is ON.

When measured tension is lower than 'zero tension alarm value'(Code RLO), zero tension alarm indicator '**AL**' will be lit and at the same time the alarm relay will be 'ON', generate an alarm signal. Zero tension alarm don't act in Run/Stop and reel exchange progress.

The indicator **'COM'** flashes when the controller is in active communication with a host computer.

7.2 Modifying the Operation Parameter

When the controller is in the PV/SV displaying status, press PAR/SET key and hold for 3 seconds reveals the first parameter. The parameter value can either be modified with the ▲ or ▼ key, or left unmodified. Press PAR/SET key again, the next parameter and its current value appears, the modified data has been saved.

If the last parameter is displayed or there's no key operation within 16 seconds, the menu times out automatically.

Operation Parameter List

SN	Mnemonic	Parameter	Adjustable Range	Comments
1	RL.n	Start speed	0.1~30.0%	Appears if SYnt = on If V_{IN} > RL.n, system starts If V_{IN} < RL.n, system stops
2	RLO	Zero tension alarm value	0.0~999.9 Kg	Only alarms while running
3	P.on	Start output value	0~100.0%	Available when PL.on = HAnd
4	t.on	Start time	1~30.0 seconds	
5	P.oFF	Stop output value	0~100.0%	
6	t.oFF	Stop time	1~30.0 seconds	
7	ProP	Proportional band	0.1~999.9 Kg	The smaller ProP value, the faster response The greater ProP value, the slower response
8	Int.t	Integral time	0.1~10.0 seconds	The smaller Int.t value, the faster response The greater Int.t value, the slower response
9	db	Dead band	0.1~999.9Kg	The greater db value, the more stable but slower response.
10	P.chA	Reel exchange output	0~100%	
11	t.chA	Reel exchange time	1~30.0 seconds	
12	out2	Output 2	0.0~100.0%	
13	dI	Speed Synchronous Coefficient	-2.00~2.00	Appears when the speed synchronous tracking function is enabled.(P.n2 = on)
14	Loc	Configuration password	0~9999	Set to 808 to enter the configuration menu

7.3 Software Configuration

The TC950 tension controller must be configured properly in order to perform the correct control function.

How to enter software configuration menu:

1) Press PAR/SET key and hold for 3 seconds to enter the first level menu(i.e. operation parameter list);

2) Press PAR/SET key to scroll the parameter to Loc and set its value to 808(the initial password);

3) Press PAR/SET key, the first parameter appears on the upper display, at the same time the lower display will display the value of this parameter. The values can be modified by pressing keys ▲ and ▼. After modification, press the PAR/SET key, the next parameter appears, at the same time, the modified data has been saved in the memory.

If the last parameter is displayed or there is no key operation within 16 seconds, the controller will return back to the PV/SV display status.

After configuration, set the configuration password(code Loc) to data other than 808 in order to protect the parameter values from being inadvertent modification.

Software Configuration Paramter List

SN	Mnemonic	Parameter	Adjustable Range	Comments
1	SP H	Tension setpoint high limit	Measurement Range	always > SP L
2	SP L	Tension setpoint low limit	Measurement Range	always < SP H
3	H PL	Max output power	0.0~100.0%	
4	PLI	"Speed synchronous tracking" Power Limitation	0.0~100.0%	Appears if P.n2 = on
5	OFSt	Input/calibration offset	-9.99~10.00	
6	Sn	Display units of input signal	tc .tc	without tenths' precision with tenths' precision
7	Addr	Instrument address	00~99	
8	bAud	Baud rate	2400, 4800, 9600, 19.2	
9	CtrL	Control algorithm	P.d r SP	Constant tension control Taper tension control
10	SPrr	Taper ratio	0.01~10N/min.	Appears if CtrL = r SP
11	OPI	Output 1	0-20 4-20	0~20 mA 4~20 mA
12	OP2	Output 2	0-20 4-20	0~20 mA 4~20 mA
13	ALI	Alarms	OFF H.AL LoAL	Alarms OFF Full-scale high alarm Full-scale low alarm
14	Act	Control action	d.r rEu	direct control reverse control
15	SYnt	Synchronous Run/Stop	no YES	Disable Enable
16	P.n2	Speed synchronous tracking function	on OFF	Enable Disable
17	PL.on	Start output selection	Auto HAnd	Automatic setting Manual setting
18	F.L	Input filter	0.01~99.99	
19	Proc	Tension calibration	P1 P2	zero tension calibration full-scale tension calibration

8 Operation of Tension Control System

8.1 Speed Synchronous Tracking Function

When P.mc2 = on, the 'speed synchronous tracking function' is enabled, Speed Synchronous Tracking Signal*di(Speed Synchronous Coefficient) will be added to the control output.

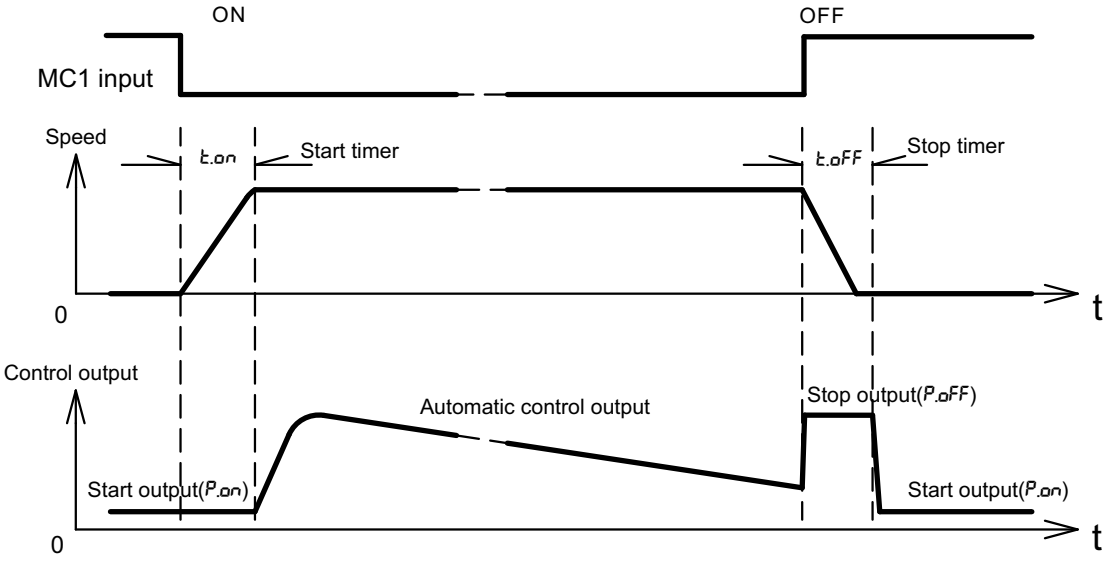
In winding systems, normally set di as positive(di > 0), when systems speed up, the control output increase with the system speed at the same time, make the system speed synchronous.

In unwinding systems, normally set di as negative(di < 0), when systems speed up, the control output decrease with the system speed at the same time, make the system speed synchronous.

When P.mc2 = OFF, the 'speed synchronous tracking function' will be disabled, the parameter di will be hidden.

8.2 Run/Stop

The run/stop operation of TC950 tension controller is controlled by terminal MC1 and MCC. Connect a switch across the terminal MC1 and MCC, the switch is called **Run/Stop switch** of the tension system. See the wiring diagram.



Starting Procedure: Before starting, TC950 outputs P.on to generate preparatory tension. When the Run/Stop switch(MC1-MCC) is turned on and after an overflow of time set in start timer t.on, the automatic control will start. At this time, indicator '**RUN**' will be lit. See the figure above.

Stopping Procedure: When the Run/Stop switch is turned off, the controller output stop power P.oFF instantly until the stop timer t.oFF times up. After that, controller outputs P.on to generate preparatory tension. At this time, indicator '**RUN**' will be turned off. See the figure above.

When '**Synchronous Run/Stop**' function is enabled(SYnt = YES), the run/stop operation is not only controlled by the MC1 input but also the **synchronous speed tracking signal(V_{in}).**

When Run/Stop switch is turned on and V_{IN} > RL.n, system starts, indicator 'RUN' will be lit.
When Run/Stop switch is turned off and V_{IN} < RL.n, system stops, indicator 'RUN' will flash.

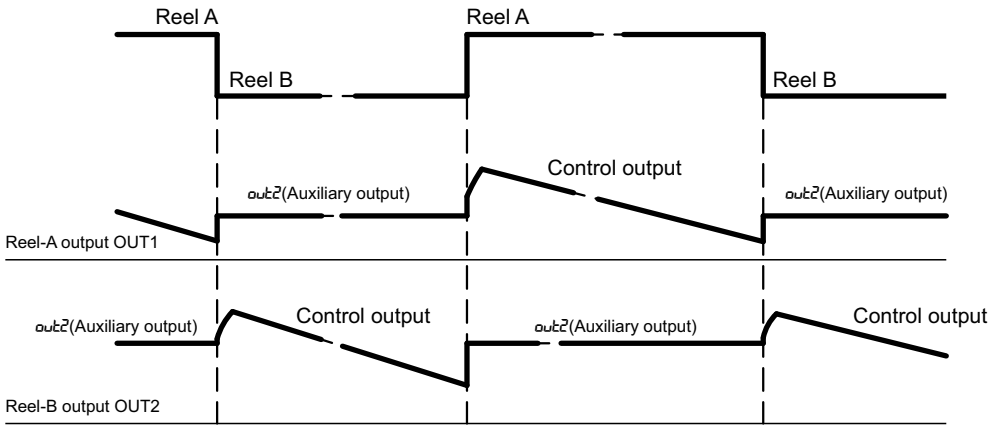
In full automatic tension control systems, generally short-circuit MC1 and MCC, the system will run/stop according to the **tracking speed** automatically. TC950 don't act run/stop operation during reel exchange process.

8.3 Start Output Selection

The system's start output is controlled by the 'start output selection' parameter(code: PL.on).
When PL.on = HAnd, the start output is P.on saved in controller memory(can be modified manually).
When PL.on = Auto, the start output is the output when system stops.

8.4 Reel exchange

In the two-reel operation, the reel exchange is controlled by the '**reel exchange**' switch(MC2-MCC). This function is applicable when material on reel is over or full.
When the switch is turned off, reel A is active.
When the switch is turned on, reel B is active.



Reel Exchange Process

Assume that reel-A is controlled by OUT1 and reel-B is controlled by OUT2.
Suppose that the reel exchange switch is off, reel A is active. At this time, if change the switch from OFF to ON, the control output exchanges to reel B. The control output is preset to P.chA. When the reel exchange timer t.chA times up, the automatic control starts. At the same time, the auxiliary output out2 is applied to reel A to brake reel A.
For exchanging from reel B to reel A, reverse above process. See the figure above.

8.5 Taper Tension Control

Set '**Control algorithm**'(Code CtrL) to rSP, TC950 is configured as **Taper Tension Controller**.

In winding tension control systems, to prevent the material from winding too tight or too loose on the reel, TC950 may be setting as **Taper Tension Controller**. This control as to increase/decrease the working tension depending on the change in winding diameter, in which the tension is controlled in accordance with the preset pattern, to suit the change in winding diameter.

The TC950 decreases the target tension according the the presetting taper ratio SPrr, to get the purpose of taper tension control.

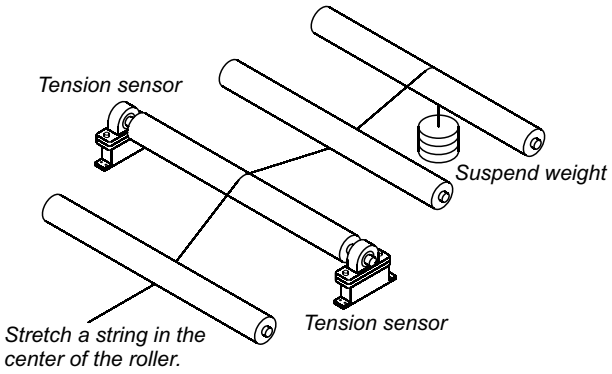
While TC950 is working in taper tension control mode and the indicator '**N**' is lit, the lower display will indicate the setting tension, when the indicator '**R**' is lit(Press DISP/SELECT key), current target tension F appears in the lower display.

When CtrL = PId, TC950 is configured as constant tension controller which is idea for unwinding tension controls.

9 Tension Calibration

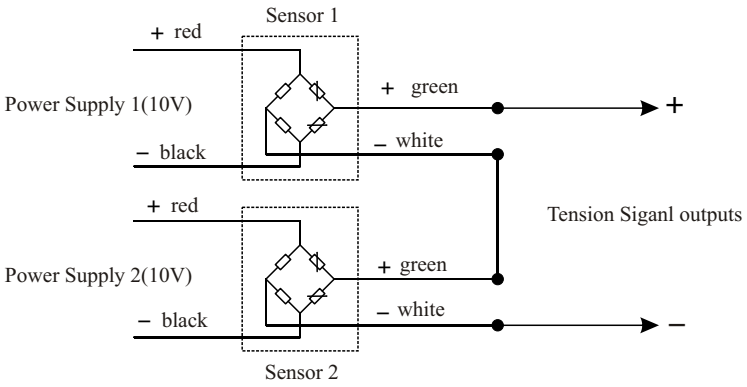
The tension controller must be calibrated after installation, and only the proper calibrated controller can get the desirable measurement precision.

The controller uses two-points linear calibration method, the process is very easy.



Input signal calibration

The input to the controller must be between -10~50mV, voltage signal which **exceed** this range must be attenuated with an appropriately sized input adapter. Current signals are converted to the -10 to 50mV range with a shunt input adapter.



Two tension sensor connection diagram

Note: Connect the tension sensor according to the wiring diagram before calibration.

9.1 Zero Tension Calibration(P1)

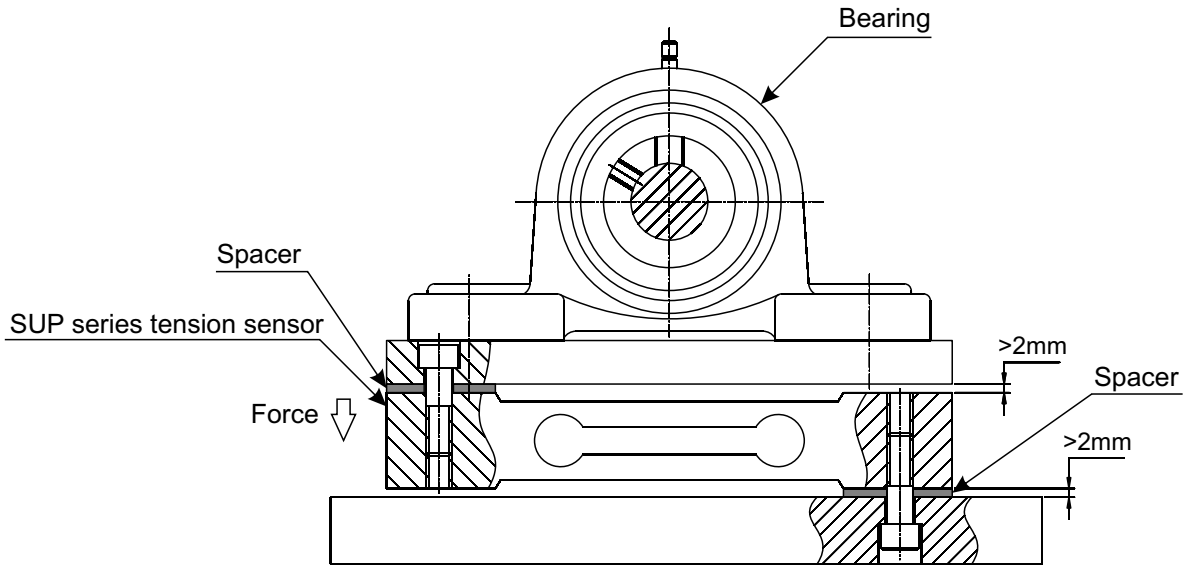
Step	Button Operation	Display
1	Turn on the power switch, add no weight on the tension sensor, press PAR/SET key until Proc appears in the upper display	Proc ----
2	Press ▲ key, P1 appears in the lower display	Proc P1
3	Press PAR/SET key, the number in the lower display will be the value after adjustment assigned to the injected input signal	P1 15.0
4	Press ▲ and ▼ key to adjust the number in the lower display until it corresponds to the represented by the injected signal	P1 0.0
5	Press PAR/SET key	0.0 no
6	Press ▲ key to affirm	0.0 YES
7	Press PAR/SET key, P1 appears in the upper and lower display at the same time	P1 P1
8	5 seconds later, the scaling of the 1st point is completed	Proc ----

9.2 Full Scale Tension Calibration(P2)

(Suppose that the max load of the tension sensor is 50.0Kg in this example)

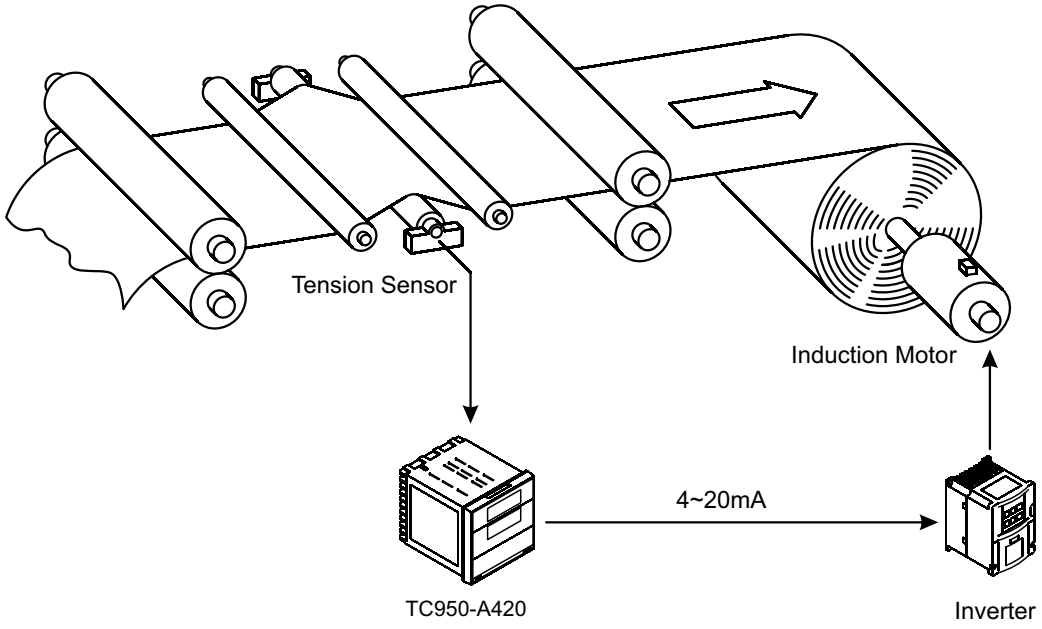
Step	Button Operation	Display
1	Load weight of 50Kg on the tension sensor, press PAR/SET key until Proc appears in the upper display	Proc ----
2	Press ▼ key, P2 appears in lower display	Proc P2
3	Press PAR/SET key, the number in the lower display will be the value after adjustment assigned to injected input signal	P2 45.0
4	Press ▲ and ▼ key to adjust the number in the lower display until it corresponds to the value represented by the injected signal(here 50)	P2 50.0
5	Press PAR/SET key	50.0 no
6	Press ▲ key to affirm	50.0 YES
7	Press PAR/SET key, P2 appears in the upper and lower display at the same time	P2 P2
8	5 seconds later, the scaling of the 2nd point is completed	Proc ----

Appendix A: The Mounting of SUP Series Tension Sensor

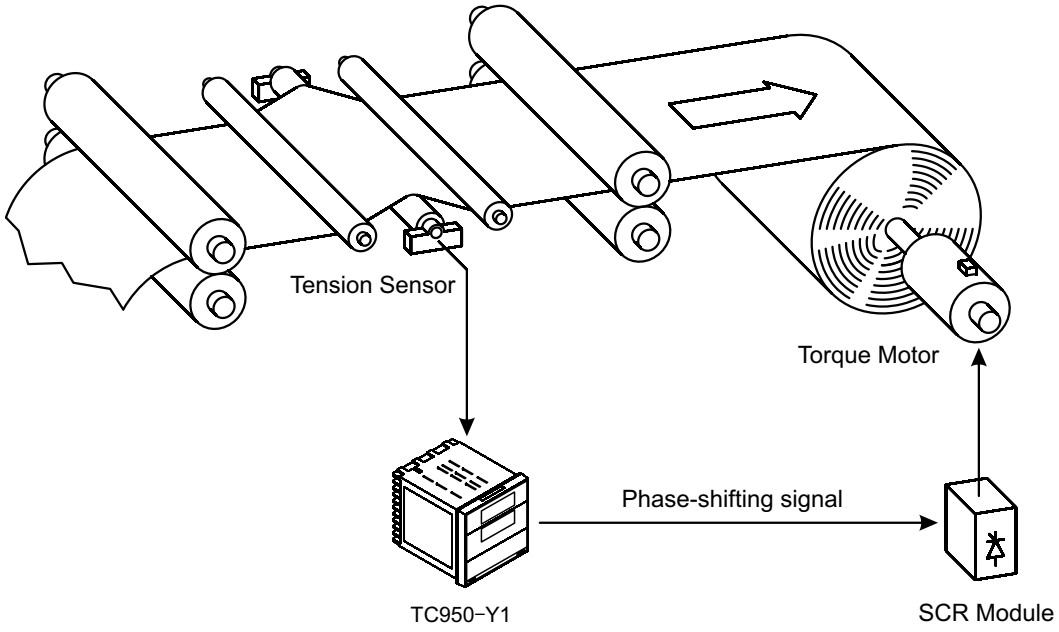


Please note that the force direction of tension sensor.

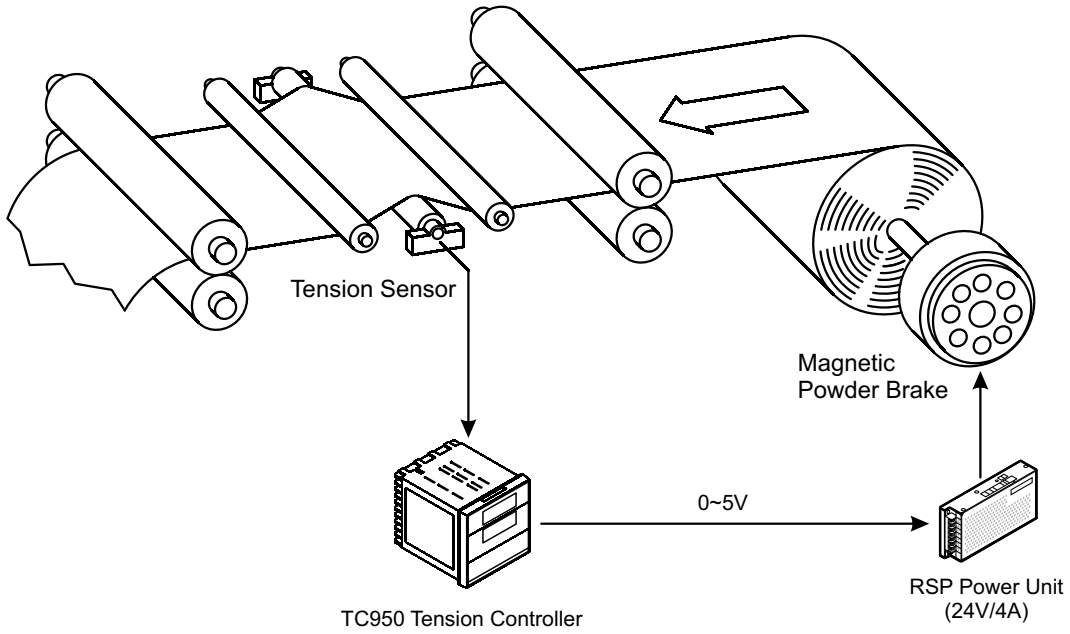
Appendix B: TC950 Typical Application 1



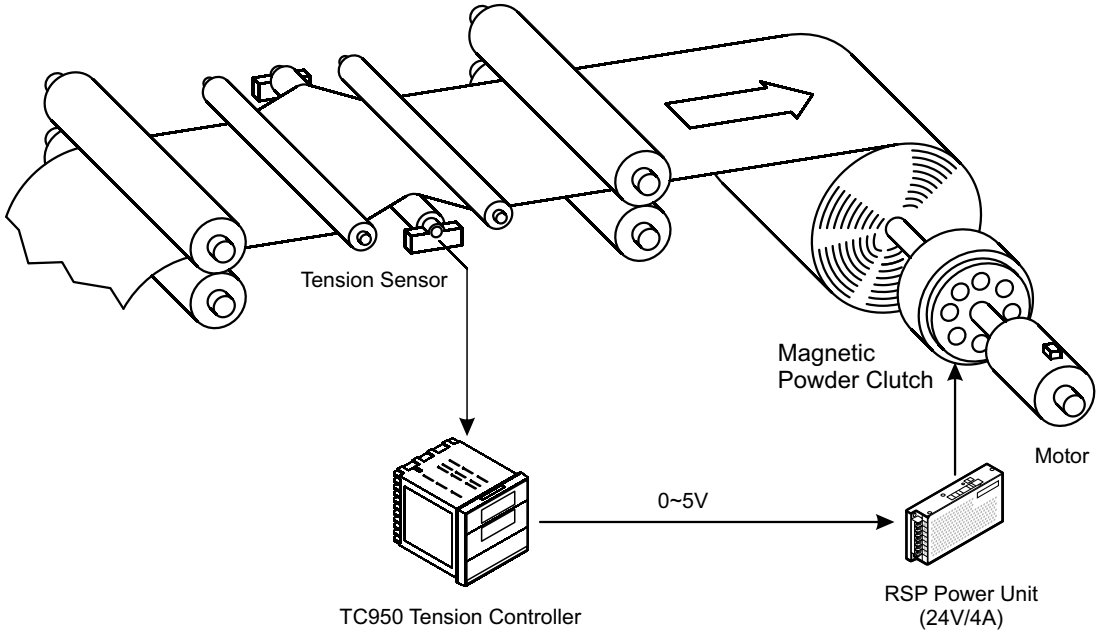
Appendix C: TC950 Typical Application 2



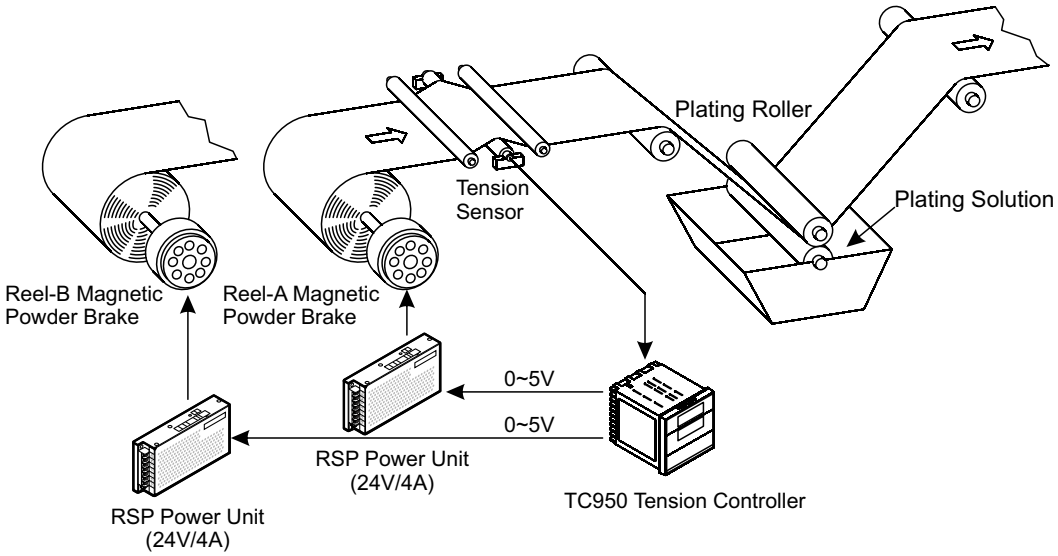
Appendix D: TC950 Typical Application 3



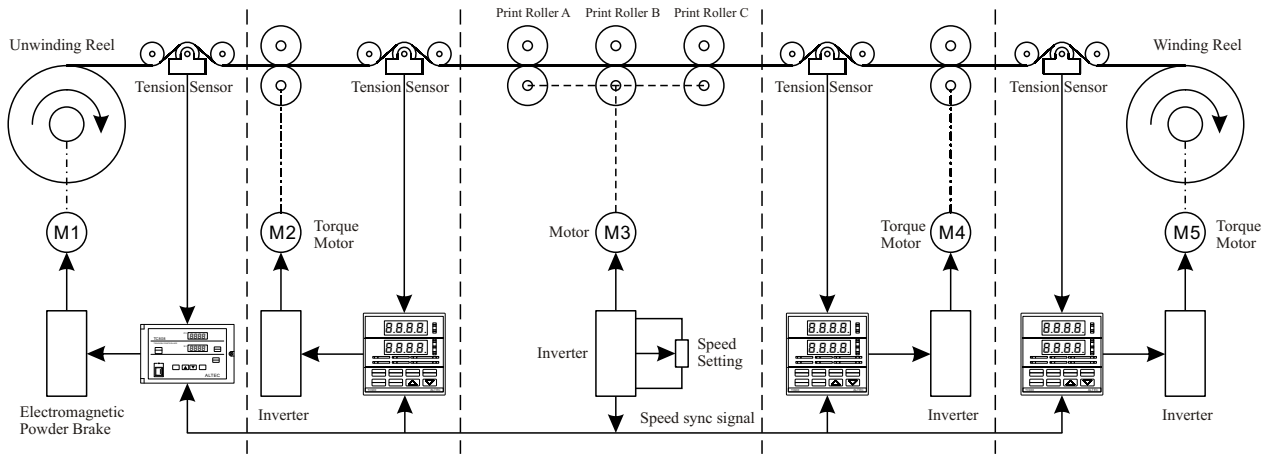
Appendix E: TC950 Typical Application 4



Appendix F: TC950 Typical Application 5



Appendix G: TC950 Typical Application 6



Technical Data

Resolution	± 0.2%FS ± 1 digit
Sampling rate	100 ms
Tension signal input	0~50 mV
Outputs	Analog, 4~20mA, 0~20mA, 0~10V PWM Phase-shifting output
Alarm	Relay, NO, Max.250VAC, 2A Zero tension alarm
Control algorithm	PID
Communications	RS232 RS485
Power supply	100~260VAC, 50/60 Hz
Environmental	Ambient temperature: 0~50 °C Relativity humidity: ≤85%
Dimensions	96mm(W)*96mm(H)*100mm(D)