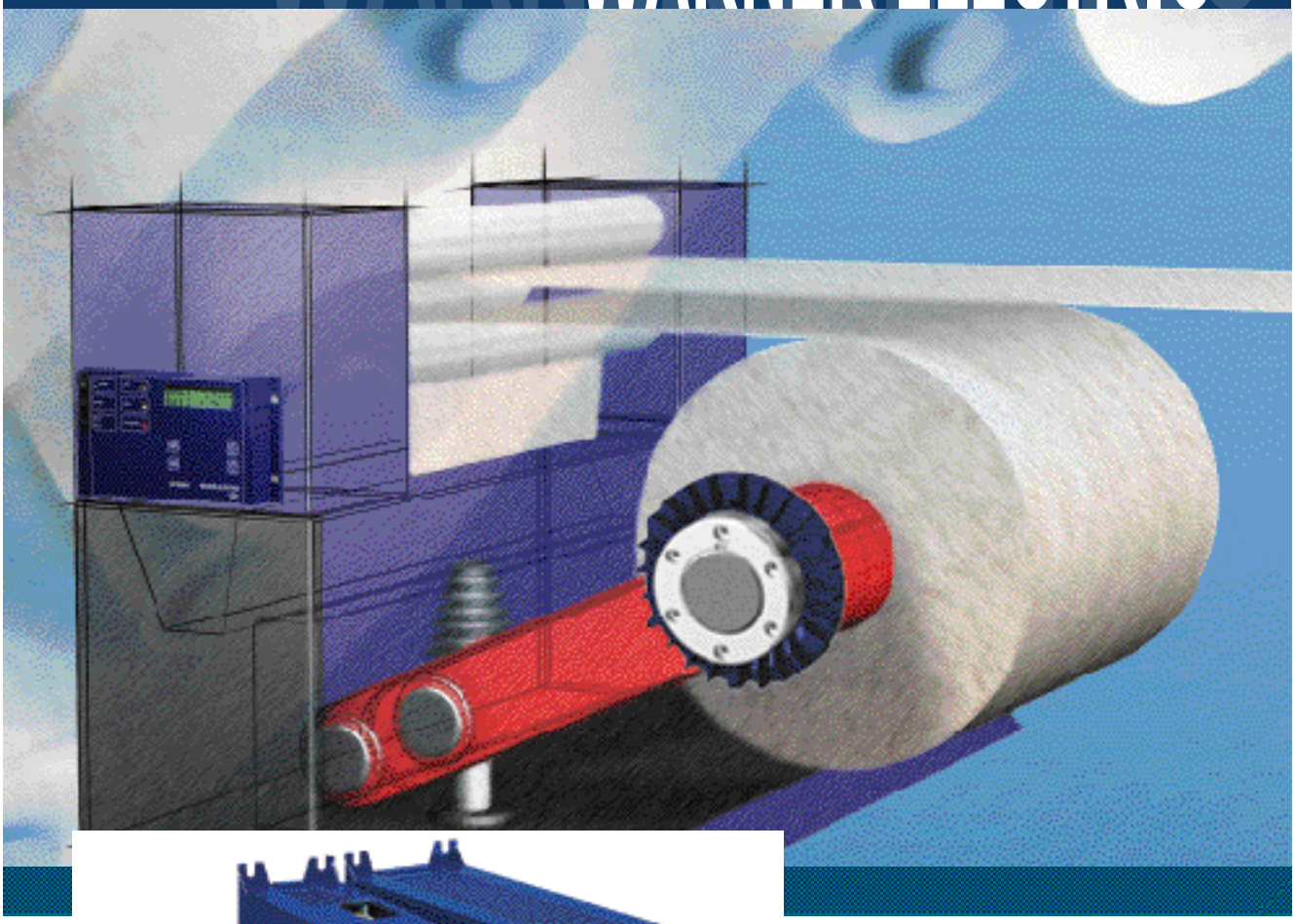
RETOUR
BACK

WARNER ELECTRIC



Tension Control Systems

Warner Electric

Tension Control Systems

WARNER ELECTRIC offers the most complete product line dedicated to the TENSION CONTROL MARKET. The long experience in the market led us to develop high performance controls able to operate in open and closed loop with brakes and motors. **WARNER ELECTRIC** electromagnetic brake find an optimum use in tension control when associated with the new digital control line.

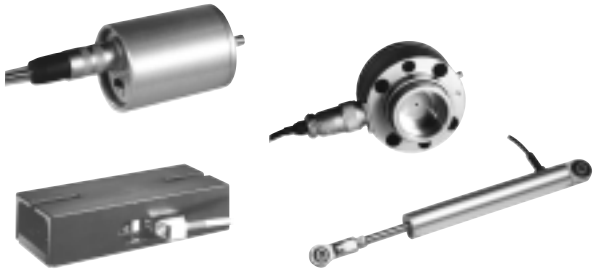
ABOUT THIS CATALOGUE

This master catalogue groups all the solutions / products that WARNER ELECTRIC offers. An important part is dedicated to the solution design with particular consideration regarding the machine and the tension control installed. This should help you for the right solution choice taking in consideration the results you want to achieve. All the product characteristics and dimensions are included for every product.

Applying the appropriated Tension Control will lead you

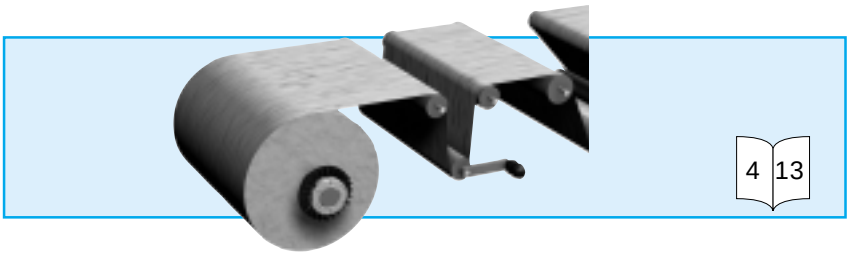
- To save material
- To improve quality of the operation
- To increase the production
- Finally to lower your production cost

ASK WARNER ELECTRIC FOR ANY ASSISTANCE YOU WOULD NEED



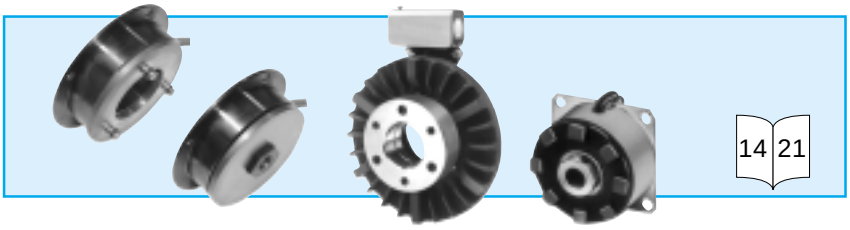
Index

MARKET / SOLUTION



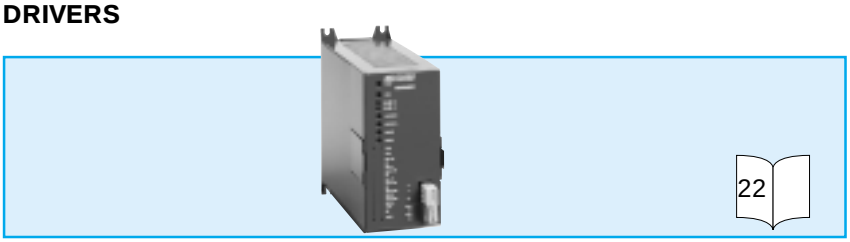
- ❒ Tension control definition
- ❒ Tension control applied
- ❒ Tension control in open loop
- ❒ Tension control in closed loop
- ❒ Torque and power determination
- ❒ Configuration selection
- ❒ Closed loop – sensor selection
- ❒ Open loop – setting selection

WARNER BRAKE RANGES



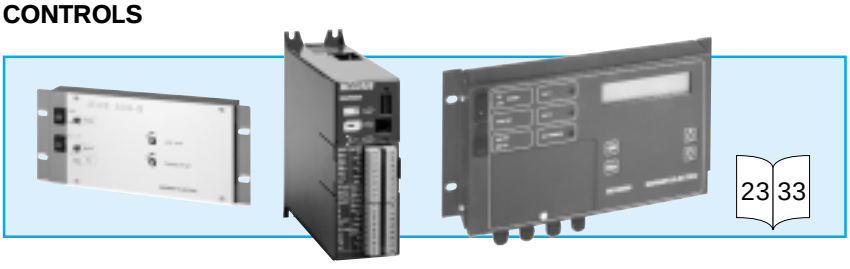
- ❒ Tension brake overview
- ❒ Tension brake sizing
- ❒ Tension brake for strapping machine
- ❒ TB brake selection/characteristics

DRIVERS



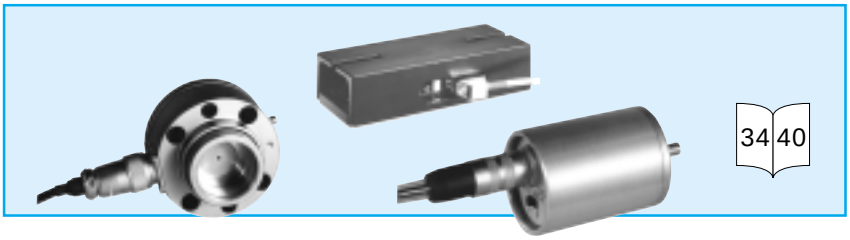
- ❒ For electromagnetic brakes

CONTROLS

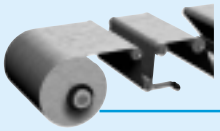


- ❒ Closed loop control overview
- ❒ MCS202-E line
- ❒ MCS2000 line configuration
- ❒ MCS2000 line characteristics
- ❒ MCS2000-ECA
- ❒ MCS2000-CTDA/CTLC
- ❒ MCS2000-important features
- ❒ Open loop control MCS2000-CTOL
- ❒ MCS2000 control line dimensions

SENSORS / ACCESSORIES



- ❒ Sensors overview
- ❒ End shaft load cell type ES
- ❒ Foot mounted load cell type FM
- ❒ Rotary sensors
- ❒ Linear sensor
- ❒ MCS2000 line - accessories
- ❒ Rotary sensors - accessories
- ❒ All sensors/accessories dimensions



MARKET / SOLUTION

Tension control definition

*Before going through the various products and solutions **WARNER ELECTRIC** can offer, it is important to make a correct analysis of the need. What we call "need" is the tension control accuracy you need to operate a good material transfer through the machine and realize perfect operation on the material.*

WHAT'S TENSION CONTROL ?

The tension control is the ability to permanently control the mechanical tension in any material (mainly the raw material available in roll size). This control has to be operated dynamically and statically. On every machine the operator should be only concerned by the speed and operation. The line speed is considered as master function. The tension control must be efficient at any machine speed phase, including machine acceleration, steady and speed deceleration.
Emergency stop case does not require accurate tension control but should act in the way to avoid the web breakage. It is then very important to consider all machine speed phases for the system determination.

WHY A TENSION CONTROL ?

When web material has to be treated in a specific machine (printer, slitter, coater….) it is very important to transport the web with a controlled tension for two main reasons :

❒ **Correct web transport in the machine**

❒ **Correct operation on the transported material**

On the other hand, this kind of machine works very often with an "edge guiding system". Loosing the tension in material will affect the correct edge guiding system.

WHERE DOES IT APPLY ?

In any roll fed web processing machine. Typically :

❒ **PRINTING machine**

❒ **LAMINATING machine**

❒ **SLITTING machine**

❒ **SHEETING machine**

❒ **COATING machine**

❒ **EXTRUDERS**

❒ **Stand alone UNWINDER / REWINDER**

❒ **In general all CONVERTING equipment**

Treating material such as:

❒ **Paper**

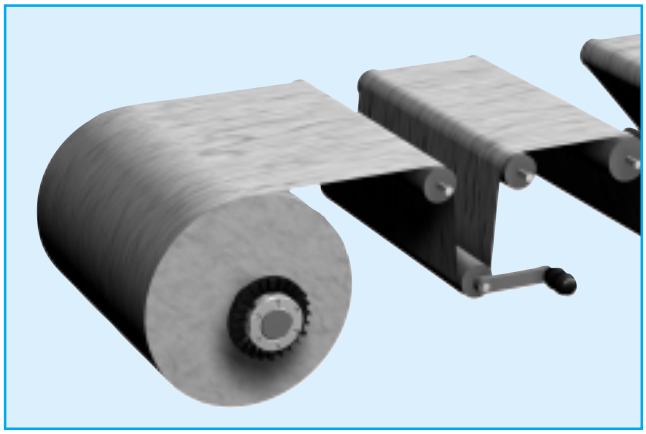
❒ **Plastic film**

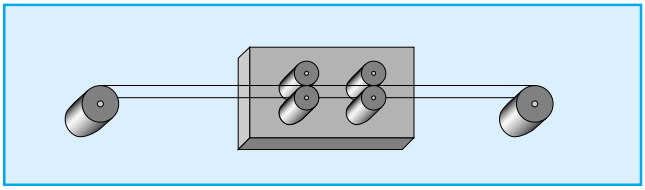
❒ **Textile**

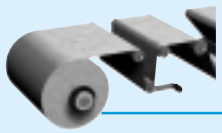
❒ **Aluminium foil**

❒ **Wires / cables**

In general in all machines whose block diagram can be represented as follows:





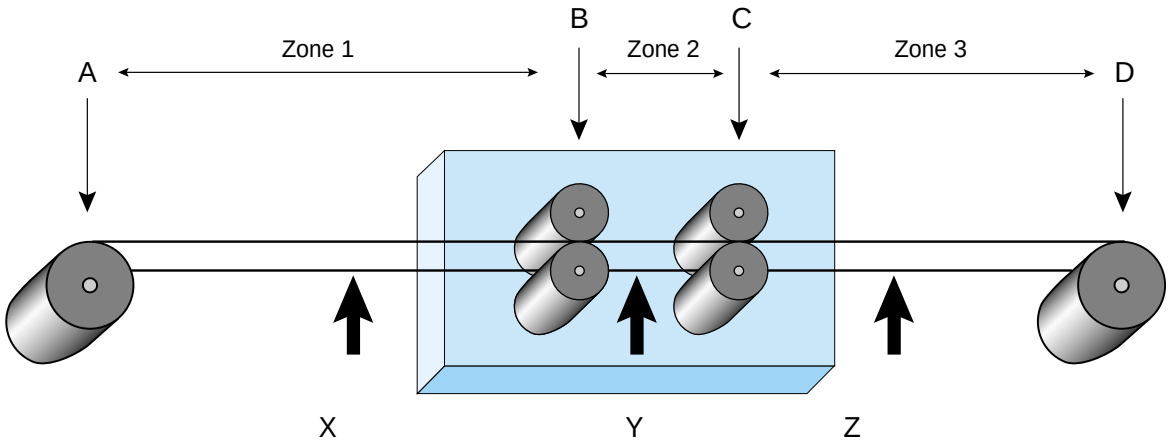


MARKET / SOLUTION

Tension control application

Analysing and preparing a project in tension control requires good analysis support. The general block diagram below is a good representation of any machine generally supporting tension control. We recommend to use this diagram or a part of it in any discussion and correspondence in order to be clear and to avoid possible misunderstandings.

GENERAL BLOCK DIAGRAM



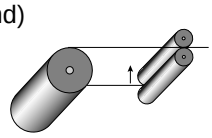
IMPORTANT CONSIDERATION

In every machine the speed point location must be clearly identified. In general one of the machine nip roll is driven setting the linear velocity of the machine. The machine speed is considered as MASTER function. The tension control, whatever the choosen solution, works in SLAVE mode. Practically, the operator sets the machine speed with a simple potentiometer and all tension control system existing on the machine have to follow, keeping the desired tension at any speed and during all transitory speed phases.

REFERING TO THE GENERAL BLOCK DIAGRAM

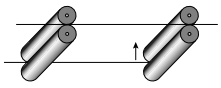
Three zones are clearly identified :

ZONE 1, Typical characteristics (unwind)



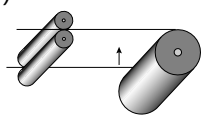
- ❒ Tension zone definition : A-B
- ❒ Speed point in B
- ❒ Variable roll rotation speed
- ❒ Variable inertia
- ❒ In general constant tension X
- ❒ Brake system applicable
- ❒ Motor system applicable

ZONE 2, Typical characteristics



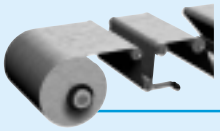
- ❒ Tension zone definition B-C
- ❒ Speed point in B or C
- ❒ Constant roll rotation speed
- ❒ Constant inertia
- ❒ In general constant tension Y
- ❒ Brake system applicable
- ❒ Motor system applicable

Zone 3, Typical characteristics (rewind)



- ❒ Tension zone definition C-D
- ❒ Speed point in C
- ❒ Variable roll rotation speed
- ❒ Variable inertia
- ❒ Constant or Taper tension Z
- ❒ Brake not applicable
- ❒ Motor system required

NOTE : Each zone is individually controlled. Tension may be different in each zone. It is assumed that there is no slipping on the nip roll.



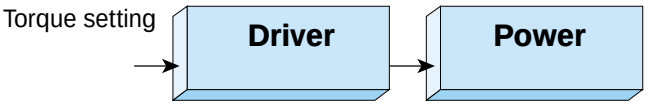
MARKET / SOLUTION

Tension control in open loop

Working in open loop requires an external reference setting applied to the driver. The torque applied to the unwind roll has to vary according to the diameter of the roll. Open loop solution is generally a low cost solution but with limited accuracy.

OPEN LOOP SOLUTION

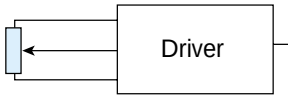
The open loop configuration does not require any control or sensor. It is composed only with a power element (brake or motor) and an associated driver. In this case the torque is not controlled. We have to set the torque on the driver according to the diameter of the roll. The electrical block schematic drawn from the closed loop system becomes as follows:



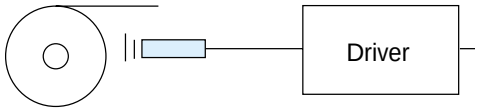
The power part is transmitting the necessary torque to the roll. Since the result is not measured, all the effect due to the inertia of the roll influence the tension in the web. Some compensations are possible but the system stays an open loop with limited accuracy.

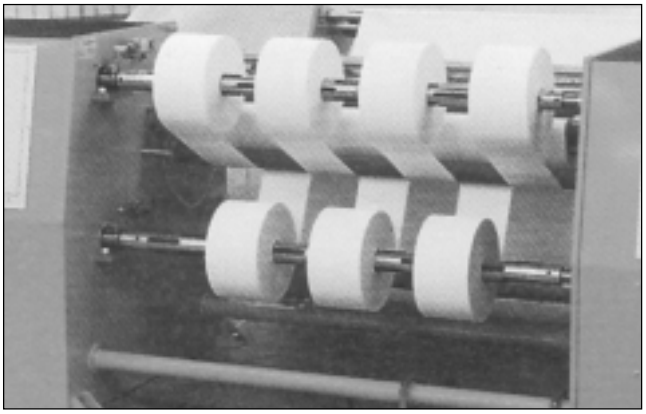
THREE POSSIBILITIES TO APPLY THE SETTING

❒ **MANUAL** by **potentiometer**

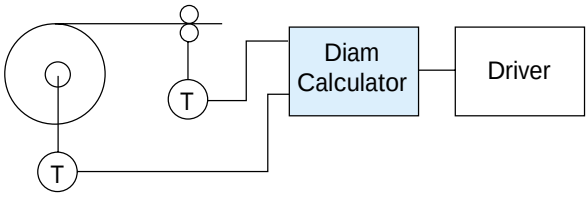


❒ **AUTOMATIC** with the **diameter reading**





❒ **AUTOMATIC** with the **diameter calculation**



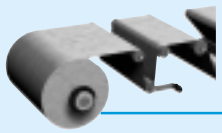
The diameter calculation is based on line and rotation speed information.

This solution requires to have both information available.

To summarize, the web tension control can be operated in two system configurations OPEN and CLOSED loop. For each configuration, three main possibilities for SETTING respectively SENSING are possible. The solution choice depends on :

❒ First the accuracy you need in your web tension
❒ The mechanical construction of the machine
❒ The degree of automation you need
❒ The acceleration/deceleration imposed on the system

In the next section WARNER ELECTRIC gives you some criteria to facilitate your choice. It's not our intention to impose a solution but just to offer a guide drawn from the WARNER ELECTRIC experience. We put the accent on the limit of various possibilities in order to start your project on a healthy base and really get the result you are expecting.



MARKET / SOLUTION

Tension control in closed loop

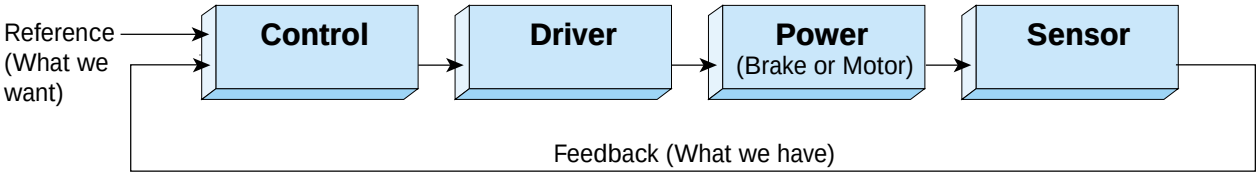
To create a tension it is necessary to apply a force or more precisely a torque when applied to a turning part. ***WARNER ELECTRIC*** *is manufacturing a wide range of brakes from fractionnal Nm to thousands of Nm. Two main solutions exist in terms of system configuration to apply the right torque:*

❒ *Closed loop control.*

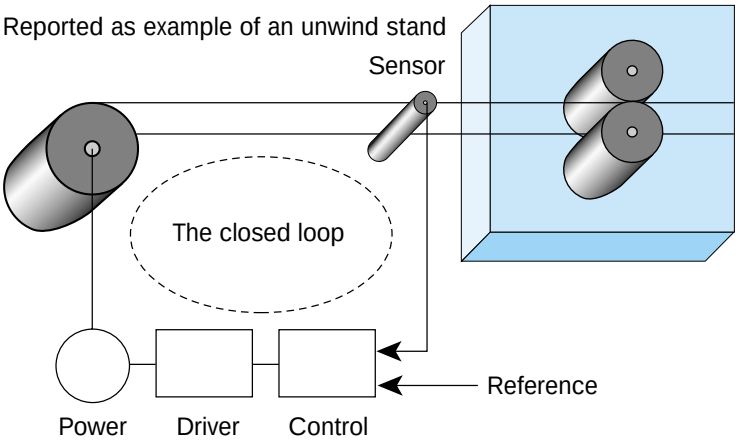
❒ *Open loop control (or more precisely open loop setting).*

CLOSED LOOP SOLUTION

The tension control, as any electronic control, is working basically in closed loop according the electrical block diagram below. In closed loop we sense the result we want to achieve and compare it with a reference in order to ensure permanent balance between what we want and what we have.



Reported as example of an unwind stand



The closed loop is an electrical/mechanical loop. It's easy to understand that in such a loop all parts are important in terms of quality.

❒ The control – has to have high performance to manage all parameter changes correctly during the operation.

❒ The driver – has to be as fast as possible in terms of response.

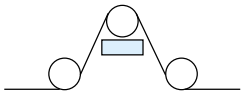
❒ The power part – has to be sized correctly according to the need and as fast as possible in terms of response.

❒ The sensor – has to be accurate, stable over time and to have a good repeatability.

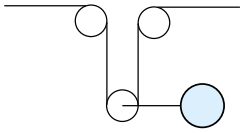
The quality of the mechanical construction is important. The control loop is closed through the mechanical transmission between the power element and the sensor roll. The web itself is a part of the loop. In the case of webs with high elasticity, special consideration should be given in control setting.

THREE WAYS TO SENSE THE TENSION

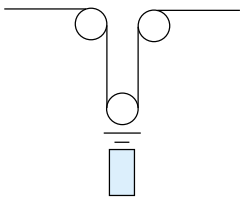
❒ **Direct tension** measurement with **LOAD CELL.**

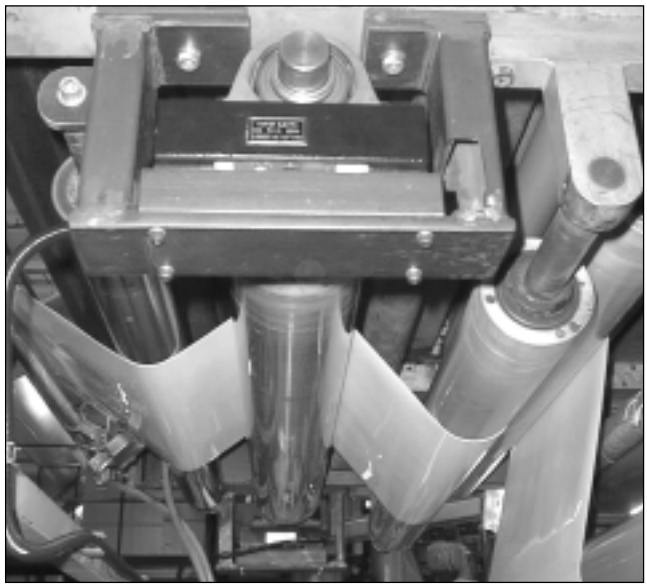


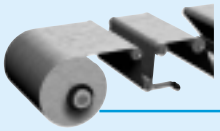
❒ **Indirect tension** measurement with **DANCER ARM.**



❒ **Indirect tension** measurement with **FREE LOOP.**







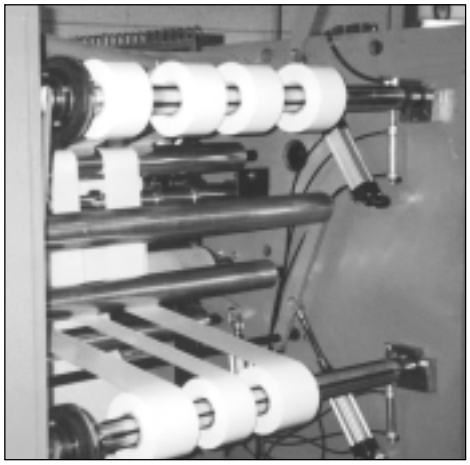
MARKET / SOLUTION

Torque and power determination

Let's take, as an example, a complete slitter-rewinder machine in order to establish a complete "power balance" sheet about the torque. The power we need in the three machine zones is the following:

- ❒ *Unwind part (zone 1)*
- ❒ *Machine process part (zone 2)*
- ❒ *Rewind part (zone 3)*

"POWER" FROM MOTOR OR BRAKE ?



Based on two parameters :

- ❒ Do I need a positive torque or is a negative torque sufficient ?
- ❒ Which technology is on the machine ?

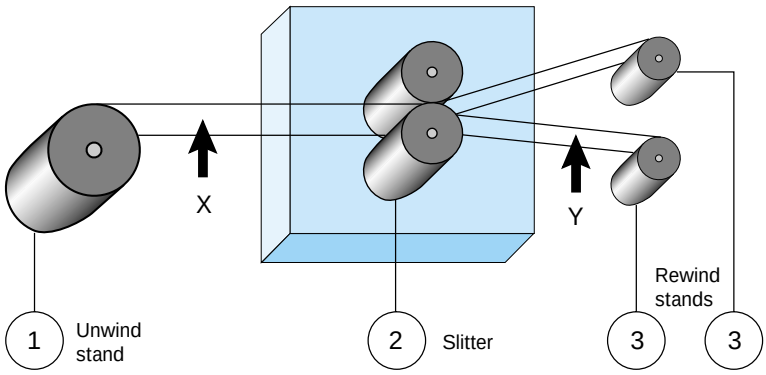
In the case where the "torque need" calculation shows positive results we are forced to use a motor. Only a motor is able to provide positive torque. It's typically the case on the rewind stand. On the other hand, for the unwind stand the brake solution very often suits the requirements.

The technology parameter is purely a customer decision. The tension control with motor is today operated with AC motor and flux vector control drive with full power regeneration in the line.

WARNER ELECTRIC offer both solutions with a wide range of products.

TORQUE NEED EVALUATION

Example of calculation on a typical machine (slitter / rewinder).

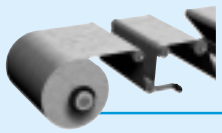


Parameters given	
Unwind tension zone X	250 N
Rewind tension zone Y	100 N, all rolls
Taper tension zone Y	40%
Max unwind roll diam.	1 m
Max rewind roll diam.	0,5 m
Min unwind roll diam.	0,09 m
Min rewind roll diam.	0,06 m
Max line speed	400 (m/min)
Accel	50 m / min / sec
Decel	150 m / min / sec
Max unwind roll weight	500 Kg
Max rewind roll weight	80 Kg, all rolls

Unwind stand (zone 1)

Max torque to provide the tension	- 1 m * 250 N / 2	-125 Nm
Min torque to provide the tension	-0,09 m * 250 N / 2	-11,25 Nm
Inertia of the full roll	0,5 * 500 Kg * 0,5 m * 0,5 m	62,5 Kgm^2
Max rotation speed (at full line speed)	+ (400 m/min / 0,09m / 3.14)	+1415 rpm
Min rotation speed (at full line speed)	+ (400 m/min / 1m / 3,14)	+127 rpm
Torque to accelerate the full roll	+ (62,5 Kgm^2 * 127 rpm / 9,55 / 8 sec)	+104 Nm
Torque to decelerate the full roll	- (62,5 Kgm^2 * 127 rpm / 9,55 / 2,66 sec	- 312 Nm
Torque need on the roll to insure correct tension		
- In acceleration	- 125 Nm + 104 Nm	-21 Nm
- During steady speed for D to d	-125 Nm to -11,25 Nm	-125 to -11,25 Nm
- In deceleration	-125 Nm - 312 Nm	-437 Nm
- Max continuous power dissipated	- 125 Nm * 127 rpm / 9550	-1,66 kW

The torque need for each machine phase shows a negative result. Brake and motor can comply with all parameters. Whatever the choice the selection must be based on the max requirements of heat, torque and speed.



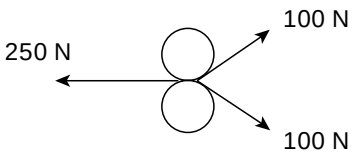
MARKET / SOLUTION

Rewind stand (zone 3)

Both shafts are similar in terms of mechanical parameters. It's practically always the case for slitting machines.

Max torque to ensure the tension (biggest diameter, all rolls)	+(0,5 m * 100N * 60% / 2)	+15 Nm
Max torque to ensure the tension (smallest diameter, all rolls)	+(0,06 m * 100N / 2)	+3 Nm
Max shaft rotation speed - In reality the max speed in never reached on the core diameter. For the max speed on the core we can assume a practical reduction of 25%	+(400 m/min / 0,06 m / 3,14)	+2123 rpm
Then max rotation speed	+(2123 rpm * 75%)	+1592 rpm
Min shaft rotation speed - In reality the full roll is never reached at full speed For the min speed at full roll we can assume a practical reduction of 25%	+(400 m/min / 0,5 m / 3,14)	+255 rpm
Then min rotation speed	+(255 rpm * 75%)	+ 191 rpm
Inertia of the full roll, all rolls	0,5 * 80 Kg * 0,25 m * 0,25 m	2,5 Kgm^2
Torque to accelerate the full roll, all rolls	+(2,5 Kgm^2 * 191 rpm / 9,55 / 8 sec)	+ 6,25 Nm
Torque to decelerate the full roll, all rolls	–(2,5 Kgm^2 * 191 rpm / 9,55 / 2,66 sec)	– 18,8 Nm
Final torque need on the roll to ensure correct tension		
- In acceleration	+ 15 Nm + 6,25 Nm	+ 21,25 Nm
- In steady speed for d to D	+ 3 to + 15 Nm	+ 15 Nm
- In deceleration	+ 15 Nm – 18,8 Nm	– 3,8 Nm
- Max power continuous dissipated per shaft	+ 15 Nm * 255 rpm / 9550	+ 0,4 kW

MAIN DRIVE NIP ROLL (zone 2)



Necessary theoretical power :

Worst tension balance = 250 N – (2 * 100 N * 60%) = 130 N

Max power need = 130 N * 400 m/min/60 = 867 W

Max roll rotation speed : depends of nip roll diameter

MACHINE POWER BALANCE

Unwind stand	– 1,66 kW
Main drive	+ 0,87 kW
Rewind shaft (2)	+ 0,80 kW
TOTAL POWER	+ 0,01 kW
(due rounded number)	0,00 kW

Please note it is a theoretical calculation. We did not take all the initial friction account. Looking at the torque need for each zone we can say:

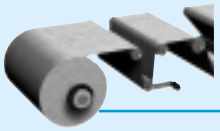
❒ Tension function on unwind stand can be achieved by motor or brake.

❒ Nip roll system has to be motor driven.

❒ Tension function on rewind shaft must be provided by motor.

WARNER ELECTRIC can offer you the appropriate solution whatever your choice: wide range of electrical brakes as well as motorised solutions.

Please see pages 14 to 19 for component selection.

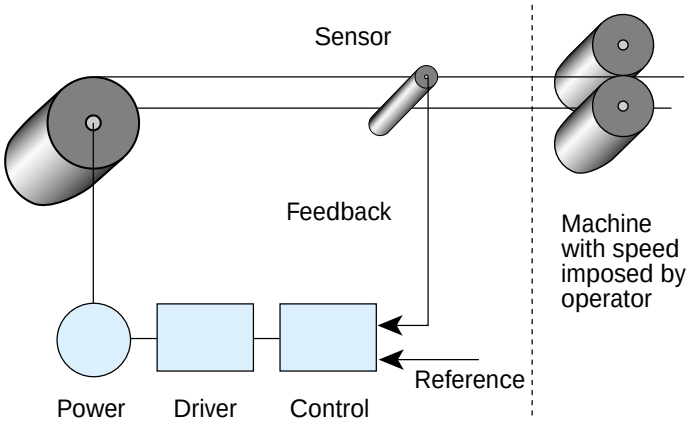


MARKET / SOLUTION

Configuration - selection

The power part selection is the same whatever the configuration. As soon as the power element and its associated drive are defined we have to determine how the system will be driven: in open or closed loop ?
As previously stated, one important factor is the ***tension accuracy*** *you need.*

CLOSED LOOP - ADVANTAGE / DISADVANTAGE



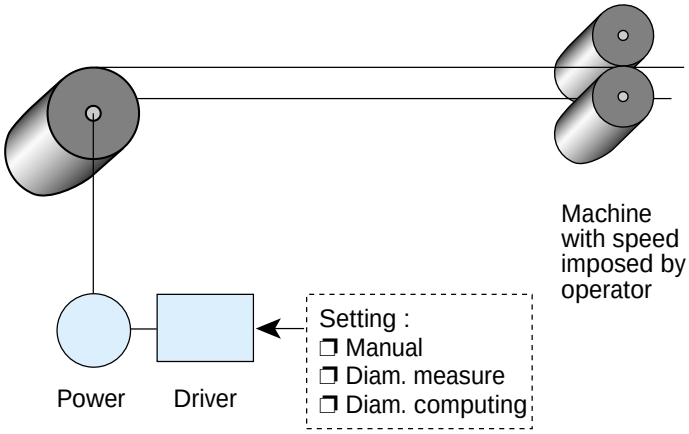
Advantage

- ❒ High accuracy.
- ❒ All initial friction in mechanical parts, even if they are changing over time are overcome.
- ❒ Tension is controlled during all the machine speed phase (accel, decel, steady speed).
- ❒ System can work in slave without any electrical connections to the machine.

Disadvantage

- ❒ Risk of instability.
- ❒ Can be more complex to set-up.
- ❒ More expensive compared to open loop.

OPEN LOOP - ADVANTAGE / DISADVANTAGE



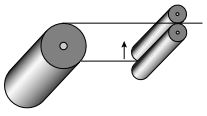
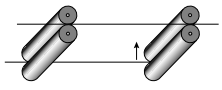
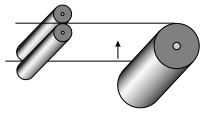
Advantage

- ❒ Very stable.
- ❒ Easy to start-up.
- ❒ Low cost compared to closed loop (sensor and control units not required).

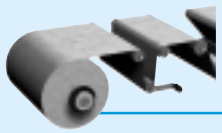
Disadvantage

- ❒ Poor accuracy
- ❒ Strongly dependent on quality of mechanical parts.
- ❒ Accel, decel phase reflected on tension.

DO NOT FORGET : all above considerations - even if example is unwind stand - are applicable to the three various machine zones we have defined on page 5.

Every zone of the complete machine can be controlled with its own appropriate tension system configuration. A typical example is the tension in a printing machine. It is very often controlled on an unwind stand in closed loop where the accuracy is important for good printing and on a rewind stand in open loop where the tension precision is not so important after the print operation.
Finally it's the customer decision. WARNER ELECTRIC can offer advise in solution and product choice.

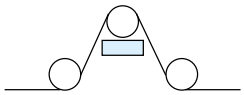
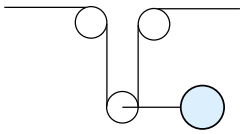
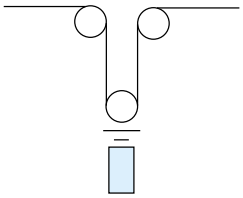


MARKET / SOLUTION

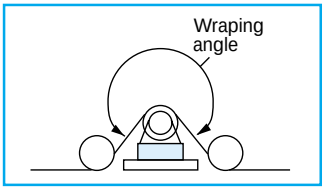
Closed loop - Sensor selection

If your machine requires a very accurate web tension control, then you need to work in closed loop. An important unit in the loop is the sensor. Three main possibilities are offered. The choice is now depending on the kind of machine you are building, the mechanical construction and the max tension value you desire to control.
***WARNER ELECTRIC** bring you their experience for selection according various criteria.*

MAIN APPLICATIONS - ADVANTAGE - DISADVANTAGE FOR THE THREE POSSIBILITIES

Type of sensor	Where, When, Why ?	Advantage	Disadvantage
Load cell 	❒ Slitter, Sheeter, Coater ❒ For heavy material ❒ Limited room ❒ No fast accel/decel ❒ Tension peak accepted	Direct tension measure Mechanically well integrated No moving part	No tension peak absorption Accel/decel machine not easy to manage Flying splice function not easy
Dancer arm 	❒ Printing ❒ Intermittent function ❒ Flying splice need	Absorb tension peak Can act as store Easy flying splice Accel / decel machine phase well absorbed Flexibility	Need more space Moving parts
Free loop 	❒ Textile machine ❒ Very low tension	Same as Dancer arm	Same as dancer arm Reliable position reading not easy

❒ In any cases the machine speed profile is important. The accel/decel machine ramps have to be electrically managed.
❒ In any mechanical construction (dancer arm), all the inertia has to be minimized.

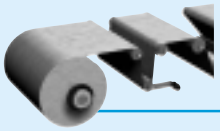


LOAD CELLS SIZING - MOUNTING RECOMMENDATIONS

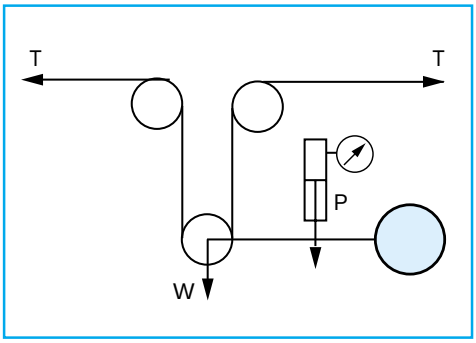
Please keep this principle in mind: The load cell installed is destined to measure the WEB TENSION and not other constraints applied to it.

Take the following points into consideration before selecting, sizing and installing material components.

❒ Load cells location should be vibration free. Vibrations will decrease quality measurement.
❒ The sensing shaft fitted on or in has to be very well balanced. Unbalanced shaft will create measurement oscillation, causing variations in control quality.
❒ Adapted ball bearing have to be used to avoid original stress on load cell (self-aligning ball bearing).
❒ Respect a reasonnable sensing shaft weight/web tension measure ratio. Less than 1.
❒ Do not oversize the load cell respect to your calculation. Max admitted factor 3, recommended 1,5.
❒ Respect a minimum wrapping angle on load cell. Min = 240°.
❒ So far as it is possible, use load cell in compression, with web tension effect in same direction as the weight of shaft.



MARKET / SOLUTION



DANCER ARM BUILDING AND OPERATIONAL RECOMMENDATIONS

Dancer arm system is used for indirect tension measurement. It is in fact a position control. The desired tension in web is provided with an external component. As general principle keep this concept in mind :

We have to create tension with force and not with a weight.

Take the following points into consideration before manufacturing, sizing and installing the components.

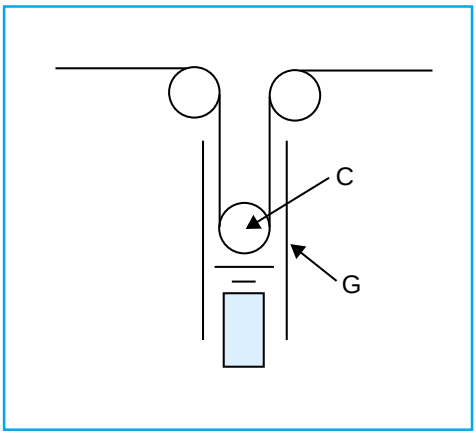
❒ Moving part of dancer has to be as light as possible.

❒ The dancer can act as both position control and web accumulator.

❒ The larger the quantity of material stored in dancer, the easier will be the position control, and hence the tension control.

❒ To set tension you need to use a pneumatic actuator “P” acting on arm of the swinging roll.

❒ In case of light tension do not add balance weights to compensate for excessively heavy dancer arms, but choose free loop.



FREE LOOP INSTALLING RECOMMENDATIONS

This is an indirect tension measure. It is in fact a position control similar to the dancer arm. The loop position is read with ultrasonic sensor. Free loop is applied especially in textile market where tension required are generally low. The free loop system suits to the requirement expressed as “zero tension”. Main difficulty is to obtain reliable position reading.

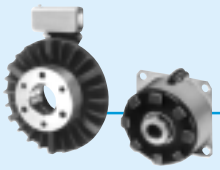
For free loop operation the following points should be taken into consideration:

❒ The tension in material is the own weight of material in the loop.

❒ A light core “C” often is placed in the loop to immobilise the loop, making easier the position reading.

❒ As the system is very light it is very sensible to the “wind”. Some guards “G” are installed to prevent accidental loop moving.

❒ As the system is dedicated to very low tension it often requires a motor as power system.

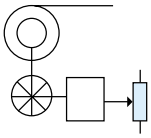
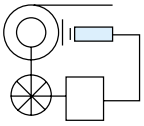
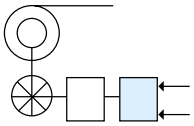


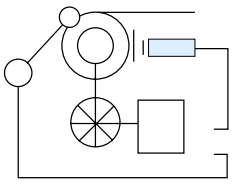
MARKET / SOLUTION

Open loop - Setting selection

Working in open loop requires that a torque setting is defined. As seen on page 7, three possibilities exist. The choice depends on the machine complexity and the automation required. One important factor that remains is the tension precision. For unwind and rewind systems the diameter ratio will play an important role. Working in open loop also requires special considerations regarding system inertia.

MAIN APPLICATIONS - ADVANTAGE - DISADVANTAGE FOR THE THREE POSSIBILITIES

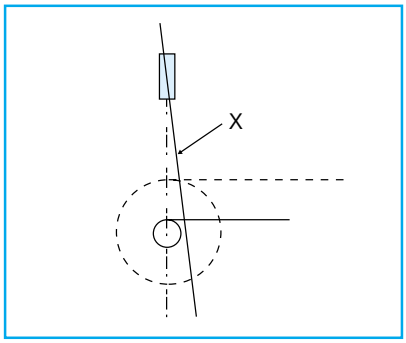
Setting type	Where, When, Why ?	Advantage	Disadvantage
Manual setting by pot. 	❒ Cable machine ❒ No fast accel/deccel ❒ Low roll diameter ratio ❒ Operator intervention admitted	❒ Low cost solution ❒ Easy to start-up	❒ Tension precision depends on operation
Diameter reading 	❒ The most commonly used solution in open loop ❒ No operator intervention admitted ❒ Large roll diam ratio	❒ Physical reading, no reset ❒ Easy to start-up	❒ Poor reading accuracy on core
Diameter computing 	❒ In rewind station ❒ In sophisticated machine ❒ Large roll diam ratio	❒ Electrically integrated ❒ Easy compensation for transitory phases	❒ Need line speed signal ❒ Need roll rotation speed signal ❒ Can be complex to set-up ❒ Need reset
❒ All solutions remain an open loop solution with limited precision. ❒ As we do not measure the result we want to achieve, all initial friction and inertia influence the precision of the system.			

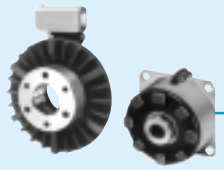


SOME PRECAUTIONS WHEN USING READING SOLUTION

Reading solution is generally with ultrasonic sensor. Another type of reading is the roll arm follower. Both use the same principle. The roll diameter measure is applied as torque setting on the power part driver. The sonic reading offers the advantage of not touching the roll. The reading reliability is the weak point of the system. Ultrasonic sensor location is important and should respect the recommendations below.

The block diagram used in all ultrasonic open loop application shows the sonic in any position. The position shown in explanation is not necessarily the ideal position to get good reading reliability. The problem when using sonic reading is to get signal reliability at the end of the roll when approaching the core. The best position when applicable is the position shown on this diagram where the sensor position axis is voluntarily offset from the theoritical vertical axis. Placing the sensor axis in X position will ensure a good and stable reading even at the end of the roll. The small error provided is not important and the reading stability is guaranteed.



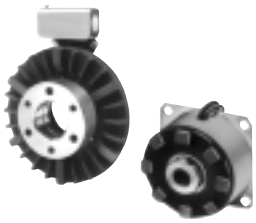


TENSION BRAKE LINE

Tension brake overview

The selection of the power part element (brake or motor) is determined by the max torque needed to ensure the tension for the max machine speed. The basic principle is to calculate the torque we need to obtain the desired max tension needed during all machine speed phases (see complete example on pages 8-9).

WARNER ELECTRIC BRAKE RANGE

BRAKE TYPE	MAIN CHARACTERISTICS	TORQUE RANGE	
TBM SIZE 10 	❒ Electromagnetic brake ❒ Monodisc ❒ 24 VDC power supply ❒ 1 size	10 Nm	16 17
TB 	❒ Electromagnetic brake ❒ Monodisc ❒ 24 VDC power supply ❒ 8 sizes	❒ 0,5 Nm to 300 Nm	18 21

WHICH TYPE FOR WHICH APPLICATION ?

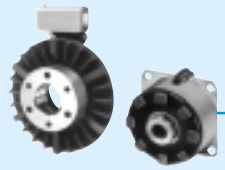
Analysing the following considerations will lead you to select the right brake for your application :

❒ The max calculated torque you need.

❒ The modularity needed.

❒ The mechanical size (square or round size, dimensions).

NOTE: The sizing of brake or motor is absolutely independent of the control system you have chosen (open or closed loop).



TENSION BRAKE LINE

Tension brake sizing

Two important parameters are used in brake selecting:
❒ *Max torque requirement*
❒ *Max thermal power to be dissipated*
These two values are determined by the application (see calculation example on pages 8-9).

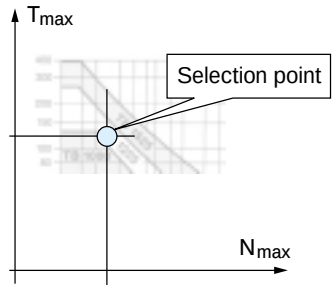
ELECTROMAGNETIC BRAKE TYPE TB - SELECTION

TB brake selection is based on two values :

Max torque need (Nm) on the brake

*Max brake rotation speed for the max torque (rpm)

* As the curve given for TB selection takes the power dissipation into account, this value is used.

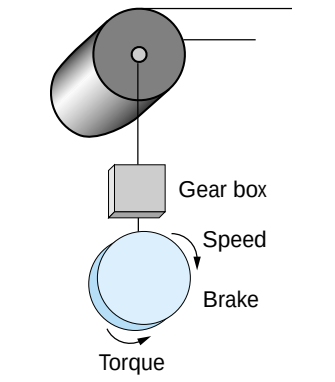


See complete selection curves page 18.

T_{max} = max torque needed at the brake for the max tension in material and the max roll diameter - taking any gear ratios into account.

N_{max} = max brake rotation speed for the max linear speed and the max roll diameter – taking any gear ratios into account.

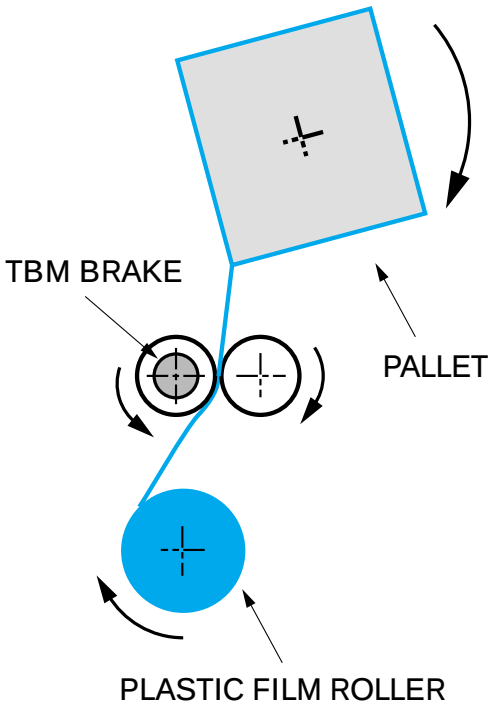
Note : the constant tension in the web gives a constant power on the brake. However, we make the selection for the max torque (then at full roll diameter) because it's the moment where the brake has the least natural cooling.



TENSION BRAKE LINE

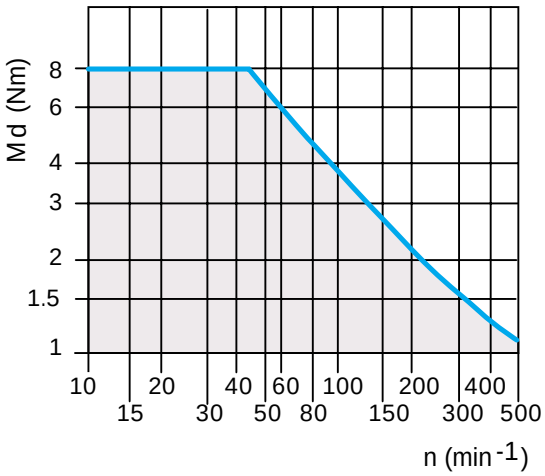
Tension brake for strapping machine

*Specially designed for strapping machine, the **electromagnetic brake TBM10** is adjustable for the different kind of plastic film. Mounted on the intermediate roller, it will tighten the plastic film and will permit a perfect strapping.*

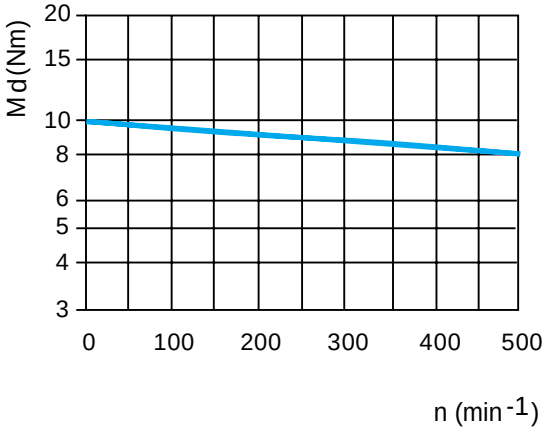


TBM SIZE 10

Heat dissipation curve



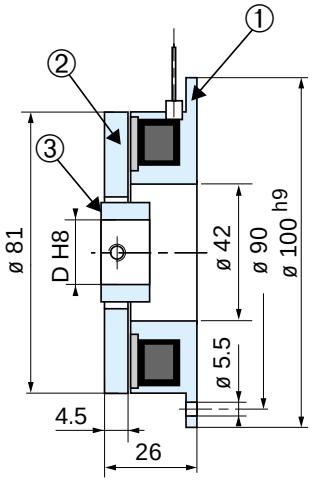
Brake torque

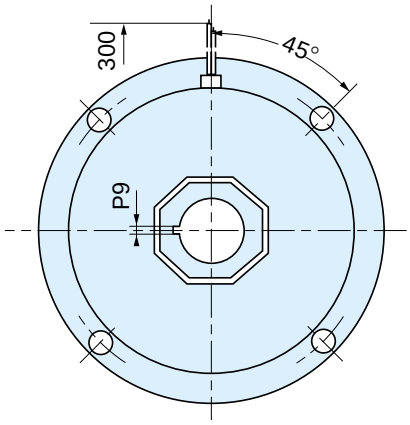


TENSION BRAKE LINE

TBM SIZE 10

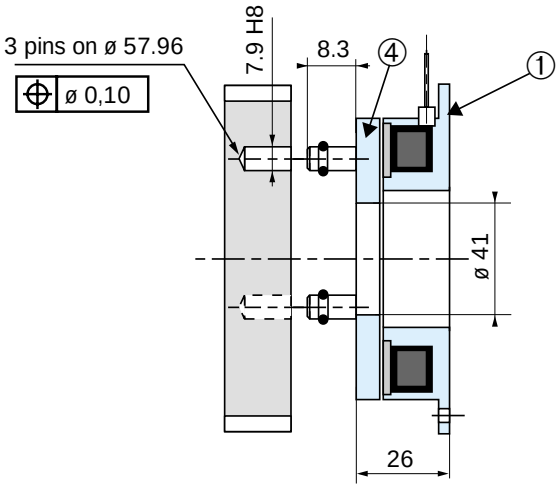
VAR 03





D min = 8 mm with standard keyway
D max = 13 mm with standard keyway

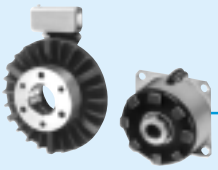
VAR 04



U max : 24 VDC - P 20°C = 10,8 Watts

Keway according to : ISO R773 / BS 4235 / NFE 22175 / tolerance P9

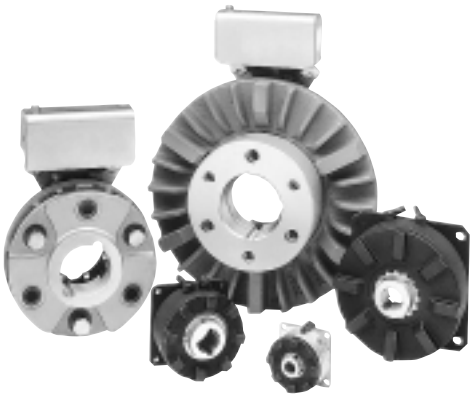
	Part	TBM SIZE 10
1	Inductor 24VDC	B6650-631-000-39
2	Armature VAR 03	B110-0000-1358
3	Hub prebored ø7,5 Hub ø12 H8 + Keyway 4 P9	B540-0000-2519 B540-0000-2517
4	Armature VAR 04	B6650-111-000-08



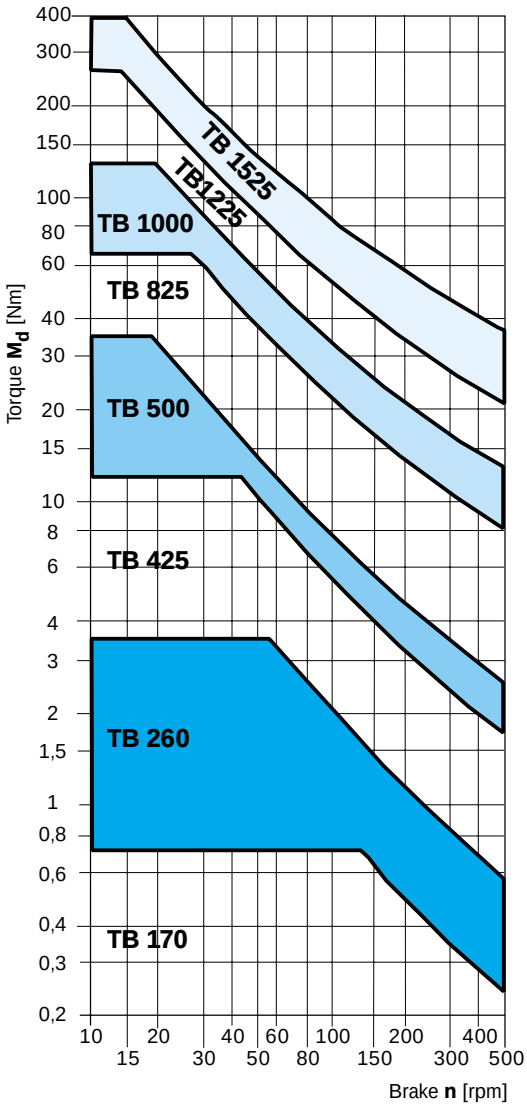
TENSION BRAKE LINE

TB Brake selection

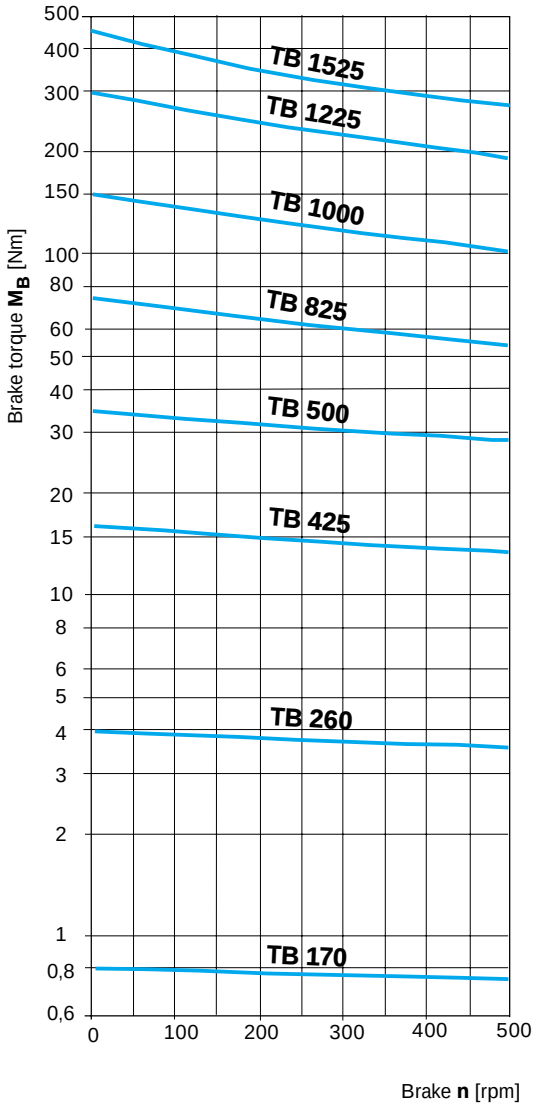
*The table (pictured below left) illustrates the selection of the correct **TB brake**. The right table determines the maximum torque provided by the brake when nominal voltage is applied. After selection you can consult the complete brake characteristics and dimensions on pages 18 to 21.*

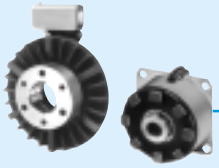


Dynamic brake selection TB170 - TB1525



Static brake torque TB170 - TB1525

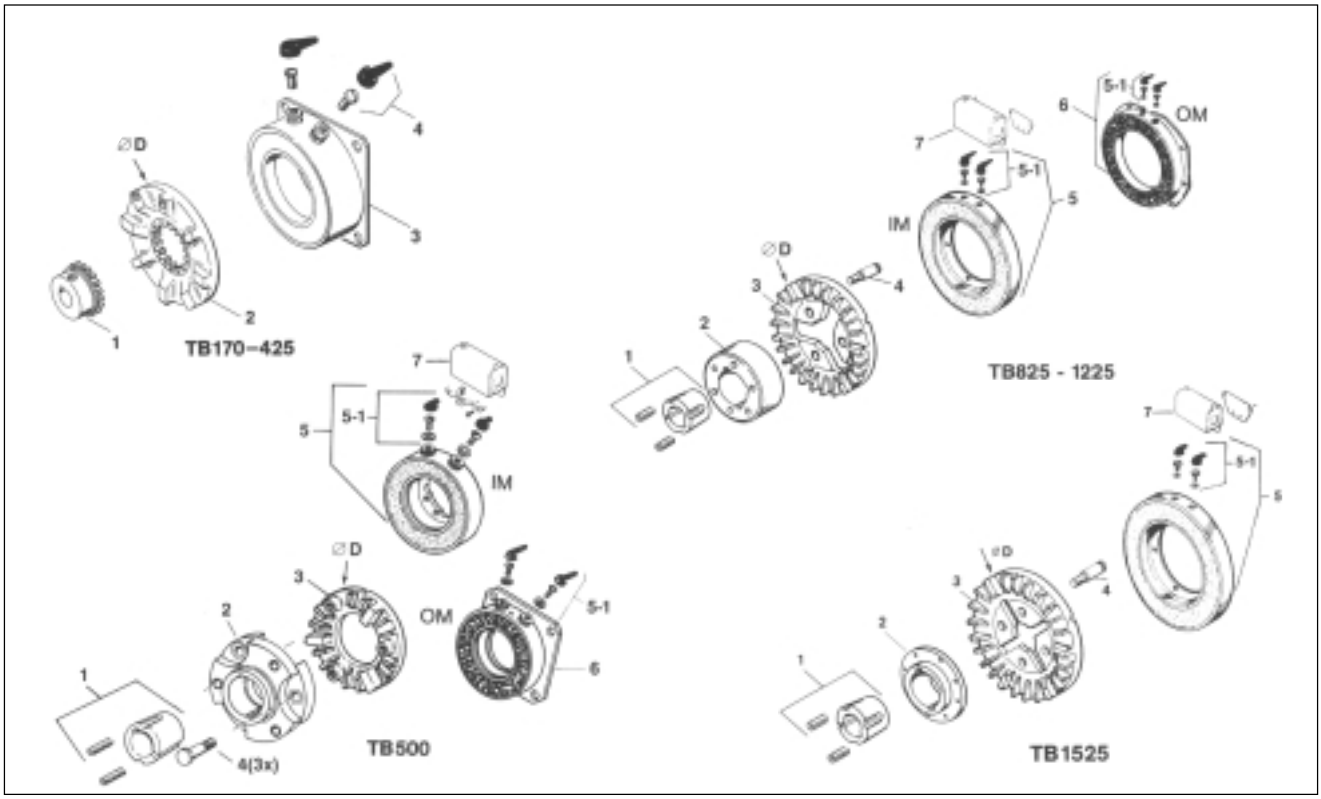




TENSION BRAKE LINE

TB Brake characteristics

TB units are assembled using various parts described below. Main components of the brake are armature and magnet. Additional parts are offered to provide for ease of mounting.



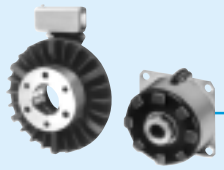
	Part	TB170	TB260	TB425
		D = 46 mm	D = 69 mm	D = 111 mm
1	Armature hub*	B5102-541-001-38	B5103-541-001-47	B5104-541-001-31
2	Armature	K110-0096	K110-0097	K110-0098
3	Magnet 24V	K375-631-012 R = 110 Ω, 20°C	K5365-631-016 R = 60 Ω, 20°C	K5367-631-008 R = 76 Ω, 20°C
4	Terminals	Wires	B5103-101-002	B5103-101-002

* Prebored

** Indicate bore and keyway

	Part	TB500
		D = 130 mm
1	Taperlock bushing**	B180-xxxx-xxxx
2	Armature hub	K5300-541-004
3	Armature	B110-0047
4	Drive pins	K5300-101-003 3 x
5	Magnet IM 24V	B5300-631-040
5-1	Terminals	B5311-101-001
6	Magnet OM 24V	B5300-631-000-46
7	Conduit box	K5200-101-010

	Part	TB825	TB1000	TB1225	TB1525
		D = 215 mm	D = 259 mm	D = 316 mm	D = 395 mm
1	Taperlock bushing**	B180-xxxx-xxxx	B180-xxxx-xxxx	B180-xxxx-xxxx	B180-xxxx-xxxx
2	Armature hub	B540-0394	B540-0313	B540-0015	B540-0314
3	Armature	B5301-111-019	B5302-111-021	B5303-111-011	B5304-111-005-04
4	Drive pins	B5301-101-001 3 x	B5301-101-001 3 x	B5301-101-001 4 x	B5301-101-001 4 x
4	Magnet IM 24V	B5311-631-000-30 R = 20 Ω, 20°C	B5312-631-000-36 R = 20 Ω, 20°C	B5313-631-000-11 R = 22 Ω, 20°C	B5314-631-000-08 R = 20 Ω, 20°C
5-1	Terminals	B5311-101-001	B5311-101-001	B5311-101-001	B5311-101-001
6	Magnet OM 24V	B5311-631-000-16	-	-	-
7	Conduit box	K5200-101-011	K5200-101-011	K5200-101-011	K5200-101-011



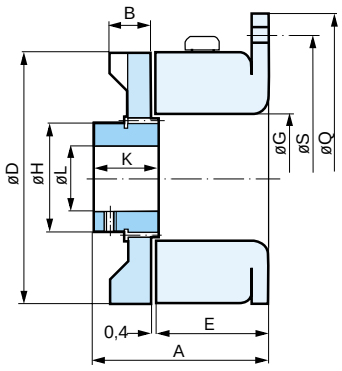
TENSION BRAKE LINE

TB Brake characteristics

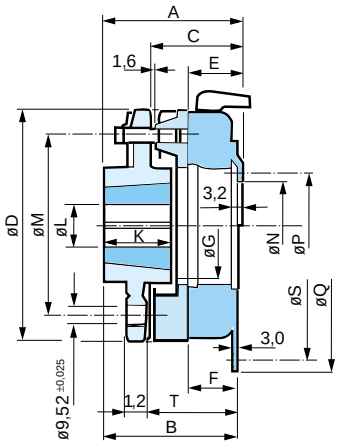
*The table below shows all characteristics and dimensions. All **TB brakes** are rated at 24 VDC nominal. When selection is correct the voltage on the brake should be approximatively 12 VDC for your maximum parameters used in calculation.*
*All **TB brakes** are able to work for short periods of time (less than 10 seconds) in the 12-24 VDC range, for example in machine deceleration.*

TECHNICAL DATA AND DIMENSIONS

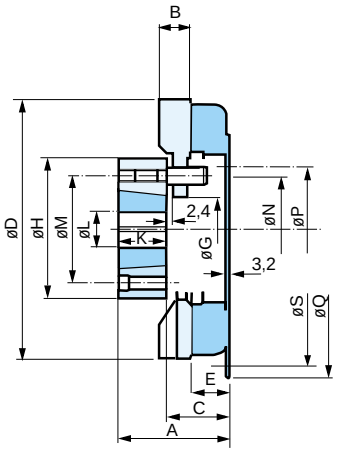
TB170, TB260, TB425



TB500 IM



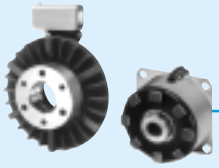
TB825 IM, TB1000 IM, TB1225 IM



TB500 OM

TB825 OM, TB1000 OM, TB1225 OM

Size		TB170	TB260	TB425	TB500	TB825	TB1000	TB1225	TB1525
M_d	[Nm]	0,8	4	16,5	35	75	150	300	450
M_d min	[Nm]	0	0,08	0,16	0,2	0,5	1,1	2	3
n max	[rpm]	5000	5000	5000	5000	3000	2400	2000	1600
I 24V =	[A]	0,22	0,40	0,32	1,010	1,177	1,224	1,076	1,212
R 20° C	[Ω]	110	60	76	23,8	20,4	19,6	22,3	19,8
t_b	[s]	0,020	0,040	0,080	0,052	0,112	0,152	0,290	0,310
Inertia	[kgm²]	$12 \cdot 10^{-6}$	$116 \cdot 10^{-6}$	$1,4 \cdot 10^{-3}$	$1,9 \cdot 10^{-3}$	0,022	0,041	0,095	0,213
Mass	[kg]	0,180	0,650	1,800	2,3	8,2	12	21	27,5
A		30,5	48,5	52	79	94	105	138	116
B		7	12	14	77	30,5	30,5	30,5	30,5
C		-	-	-	51	54	56,5	62	65
øD		46	69	111	130	215	259	316	395
E		20,6	32	30,5	30,5	33,5	36,5	41,5	44,5

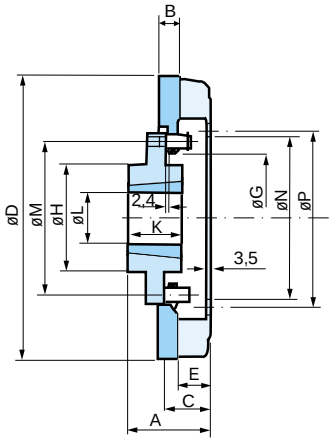


TENSION BRAKE LINE

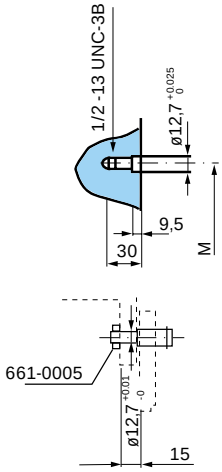
TB Brake characteristics

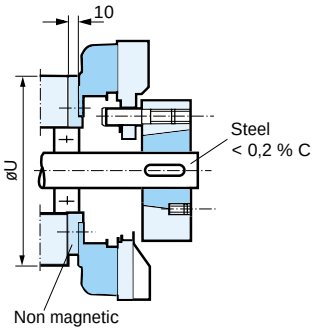
Dimension details complementary to page 20.

TB1525 IM



TB825 - 1525





Size	TB170	TB260	TB425	TB500	TB825	TB1000	TB1225	TB1525
F	-	-	-	28,5	-	-	-	-
øG	19,5$^{+0,05}$	35	62	49	55	98	114	180
øH	15,9	30,1	31,8	-	118	159	175	152,5
K*	10,3	17,5	22,2	38	38	44,5	76	76
øL max	10	20	22	32	42	60	75	75
øM$^{\pm 0,025}$	-	-	-	98,42 3 × 120°	90,49 3 × 120°	133,4 3 × 120°	149,3 4 × 90°	215,9 4× 90°
øN$^{\pm 0,05}$	-	-	-	52,40	88,93	136,55	161,95	228,60
øP	- -	- -	- -	60,3 8 × M4	108 6 × M8	155,6 6 × M8	184,1 6 × M8	247,60 12 × M8
øQ$_{-0,05}$	61,9	88,9	142,47	165,10	247,62	-	-	-
øS	54 4 × M4	79,4 4 × M4	127 4 × M6	149,2 4 × M10	255,5 4 × M8	- -	- -	- -
T	-	-	-	49	-	-	-	-
øU	-	-	-	110	170	220	260	340

* Reverse mounting of taperlock bushing is possible

DRIVERS

For electromagnetic brakes

*Considering the power element, we need to "drive" this with a **DRIVER.** The driver is the element providing the necessary power to the "power element". The driver can be considered as power interface between **CONTROL** and **POWER ELEMENT.** The driver has to be "power" compatible with the power element (electrical brake or motor) and the "signal" compatible with the control or the setting.*

ELECTRICAL DRIVER

All the TB type electrical brakes are rated for 24 VDC.

The highest current consumption is 1,24 A for the model TB 1525.

Three models are available to drive our TB brakes and all models are dual channels (two individual channels in same housing). Input and output characteristics shown below are per channel.

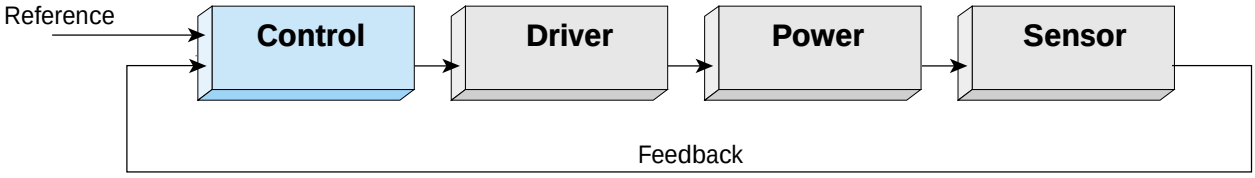
Model	Electrical input signal	Power supply / current	Output voltage / current
MCS2000-DRV	0 – 10 VDC	24 VDC/3 A	0-24 VDC/1.4 A
MCS2000-PSDRV	0 – 10 VDC	100 – 280 VAC	0-24 VDC/1.4 A
MCS2000-DRVH	0 – 10 VDC 0 – 20 mA	48 VDC/12 A	0-48 VDC/6 A /12 A peak 30 sec
MCS2000-DRV8	0 – 10 VDC	24 VDC/3 A	0-24 VDC/3 A
Wiring	Input signal shielded		
Setting	Anti-residual		
Mounting position	Vibrations free, vertically		

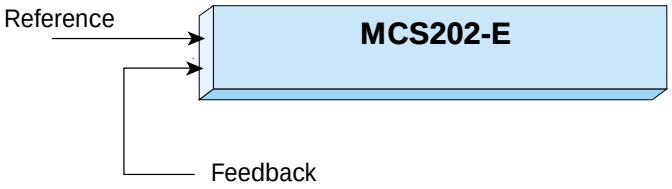
CONTROLS

Closed loop control overview

*Most tension controls work in closed loop configuration. In this case the **CONTROLLER** is indispensable. This element is the heart of the system. The control is continuously comparing the web tension information coming from the **SENSOR** with the tension reference we give to the controller. As soon as the controller detects a difference between the two values a correction is applied to the power element through the driver.*

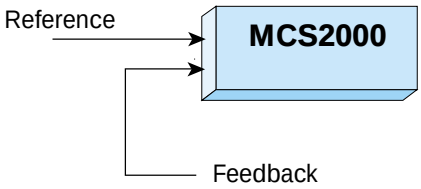
WARNER ELECTRIC CONTROL LINE OVERVIEW





Low cost analogue control **including driver** in 3 versions:

- ❒ MCS202-E1 standard version.
- ❒ MCS2000-E54 IP54 protected.
- ❒ MCS202-EC1 Open frame standard version.



Digital control in 3 versions:

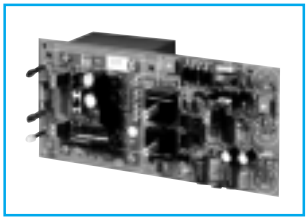
- ❒ MCS2000-ECA OEM version.
- ❒ MCS2000-CTDA user version for dancer application.
- ❒ MCS2000-CTLC user version for load cell application.

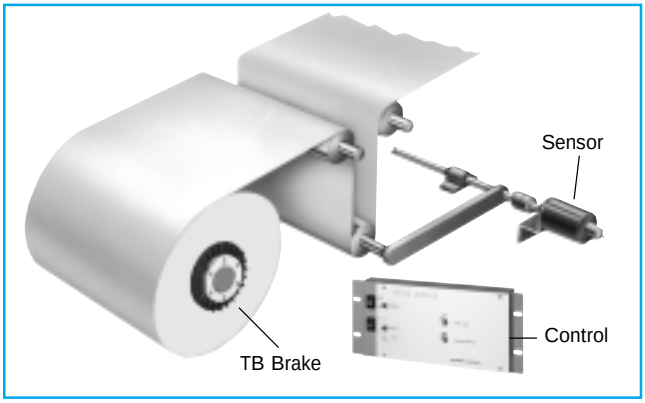
CONTROLS

MCS202-E line

*The **MCS202-E** is an analogue control. It is dedicated to electromagnetic brakes and accepts only dancer as feedback. The control is not provided with internal logic function for splice. It suits the simple application and is very easy to start-up. All connections are made by connector avoiding the wiring error risk. Warner can supply the sensor and other accessories for easy mounting.*

ANALOGUE CONTROL MCS202-E





❒ MCS202-E1 Standard execution.

❒ MCS202-E54 Standard IP54 protected.

❒ MCS202-EC1 Open frame execution.

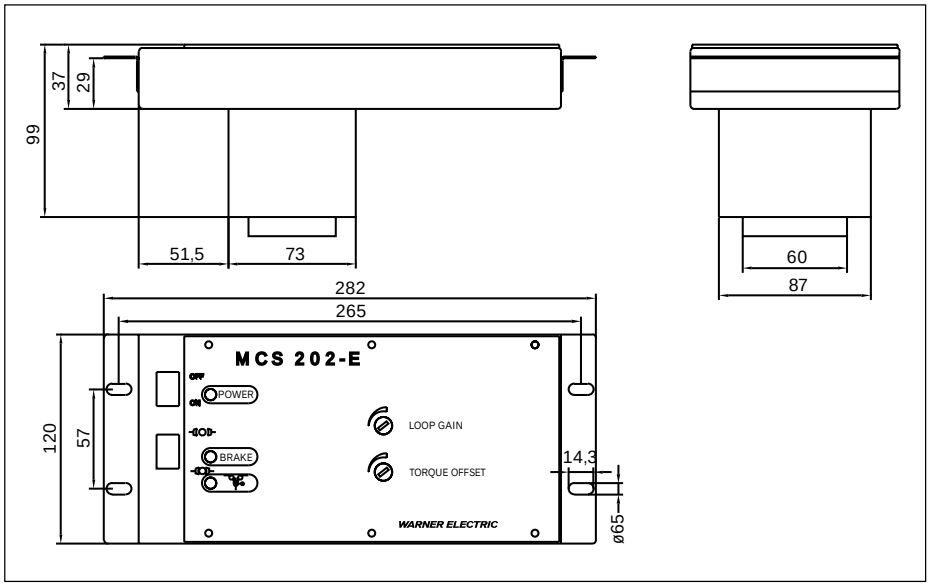
Technical Characteristics – valid for 3 executions

	Range - Values	Comments
Power supply	110-220 VAC selectable	Open front face to acceed
Output current capability	Max 2, 5 Amps, shortcircuit protected	Able to power 2 TB in parrallel
User settings	Loop gain	Front face potentiometer
	Offset torque	Front face potentiometer
Output voltage	0-24 VDC	Compatible all elec. Warner brakes
Housing	Metal rugged housing	Only MCS202-E1 and –E54
Loop gain	2 adjustable range selection	Can be change during operation
Accessories	MCS-KIT1, 2, 3, 5 and 6	See details on page 40
Sensor compatible	Dancer arm with MCS605-E	See details on pages 37 and 40

Technical information

MCS202 control is based on classical and fixed PID terms. The loop gain can be set on front face potentiometer. Due to the fixed PID terms, its use is limited in terms of roll diameter ratio. One input is provided to change the loop gain and has to be used when diameter ratio exceeds 8 to 10. To ensure proper operation it is important to wire the function “Drift Stop”. This function releases the Integral term as soon as the machine runs.

Dimensions



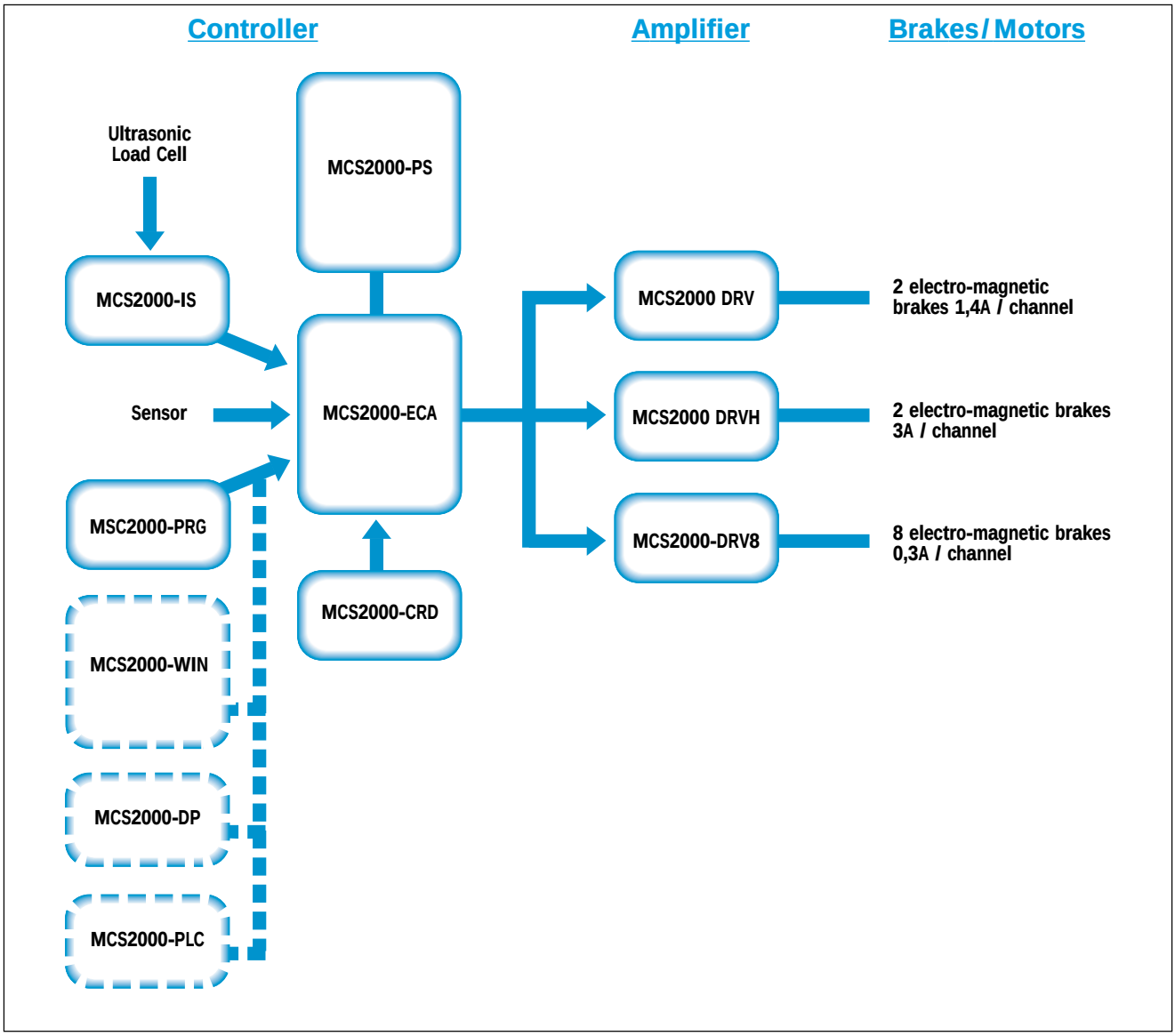
CONTROLS

MCS2000 line configuration

MCS2000 *is a product line developed around the controller* ***MCS2000-ECA.*** ***MCS2000-ECA*** *is the heart of the complete configuration grouping Driver, Power supply, Programming tool, Display, Interface sensor…*
The configuration is represented in the diagram below.

MCS2000 LINE CONFIGURATION

MCS2000-DRV8	Eight channel brake amplifier	22
MCS2000-ECA	Digital programmable controller - dual channel output.	28
MCS2000-PS	24 VDC power supply - 100-260 VAC auto-ranging input.	39
MCS2000-DRV	Dual channel brake amplifier with individual “anti-residual” adjustment.	22
MCS2000-DRVH	Dual channel brake amplifier with high output current capability.	22
MCS2000-PSDRV	Dual amplifier MCS2000-DRV and power supply MCS2000-PS in common housing.	22
MCS2000- PRG	Portable programming tool with 2 lines 16 character display.	39
MCS2000- DP	Panel mounted programming keyboard and display.	39
MCS2000-CRD	Plugable memory card with 2 full programme capacity.	39
MCS2000-IS	Ultrasonic and dual load cell interface.	39
MCS2000-WIN	Window software to interface the control to the PC (3 disks).	39
MCS2000-PLC	Codes list for PLC (terminal mode) - RS232 controller communication.	39



CONTROLS

MCS2000 line - characteristics

*Based on the **MCS2000-ECA** controller Warner has developed two additional versions as a "User Version". These two versions were obtained by grouping some existing functions in the modular configuration. These two versions make the installation and wiring easier. The programming tool – separate on the ECA version – is fitted as standard. Finally, three digital control units are available in the **WARNER ELECTRIC** range:*

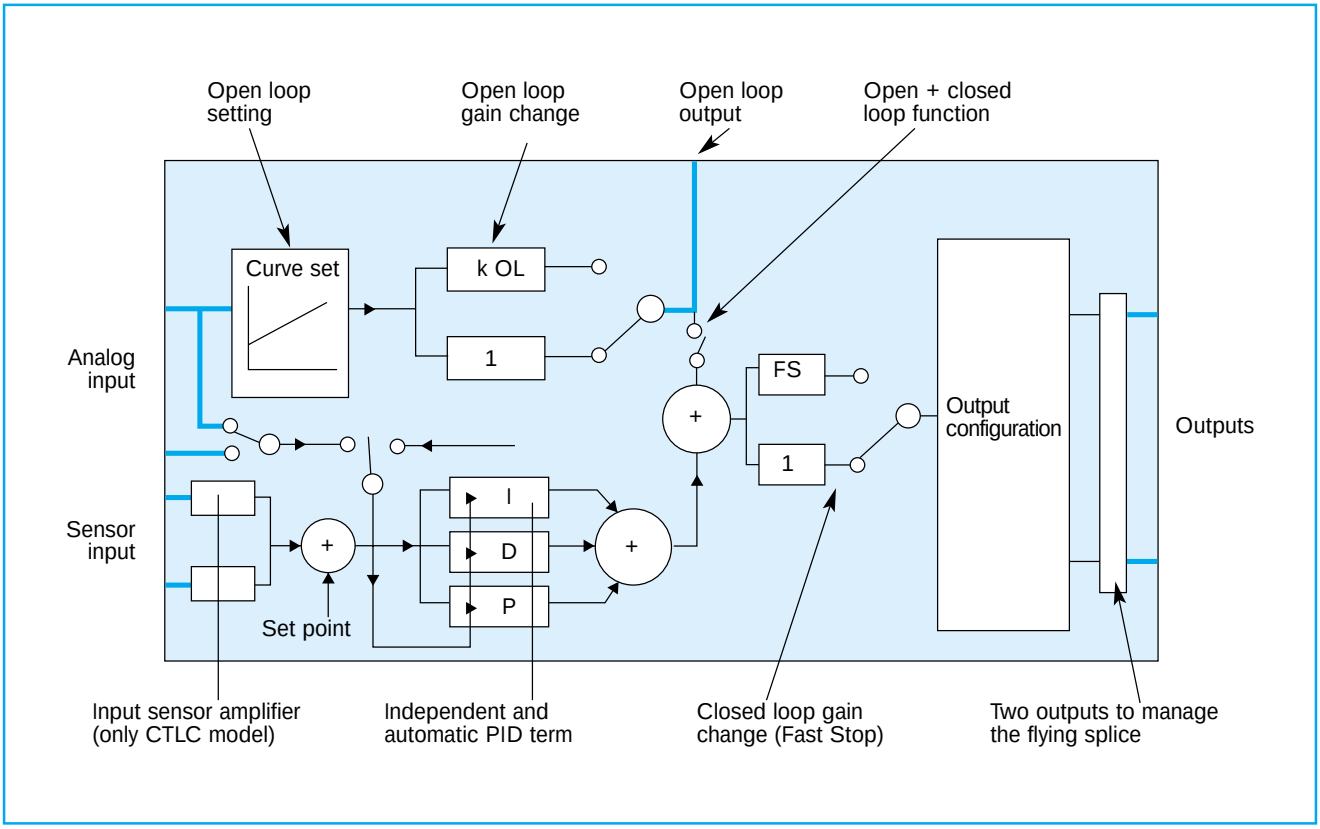
MODELS	MAIN CHARACTERISTICS	UTILISATION
MCS2000-ECA 	Open + Closed loop control PID compensation RS232 Memory card 24V power supply See details on page 28	Multipurpose OEM
MCS2000-CTDA 	MCS2000-ECA + PS + DP in same housing. 110-240VAC power supply See details on page 29	Dedicated dancer
MCS2000-CTLC 	MCS2000-ECA + PS + DP + IS in same housing. 110-240VAC power supply See details on page 29	Dedicated load cell
Use the reference below to order with various software :		
MCS2000-ECA	Standard software with RS232	Multipurpose OEM
MCS2000-CTDA-10	Standard software with RS232	Dedicated dancer
MCS2000-CTDA-11	Taper position function Limited RS232	Dedicated dancer
MCS2000-CTLC-10	Standard software with RS232	Dedicated load cell
MCS2000-CTLC-11	Taper tension function Limited RS232	Dedicated load cell

CONTROLS

MCS2000 line - characteristics

The block diagram below shows all important features installed in the MCS2000 control line. It is very important to understand all the possible configurations that the control can provide.

MCS2000 Block diagram



MCS2000 Features

Features / compatibility	ECA	CTDA-10	CTLC-10	CTDA-11	CTLC-11
Power supply 110 / 240 VAC		✔	✔	✔	✔
Power supply 24 VDC	✔				
Dancer use, one sensor input	✔	✔		✔	
Load cell use, 2 sensors input			✔		✔
RS232 communication	✔	✔	✔	✔	✔
Window software programing system	✔	✔	✔		
Taper function	✔	✔		✔	✔
Splicing capability	✔	✔	✔	✔	✔
Sensor auto-scaling	✔	✔	✔	✔	✔
Memory card support	✔	✔	✔	✔	✔
PID, individual term setting/online correction	✔	✔	✔	✔	✔
Options, accessories,	PRG				
(see details on pages 34 and 39)	DP				
	PS				
	CRD	CRD	CRD	CRD	CRD

CONTROLS

MCS2000-ECA

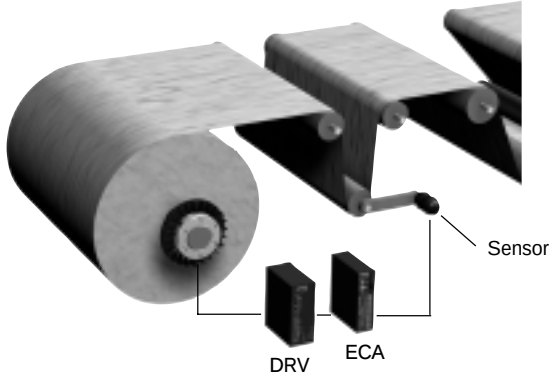
MCS2000-ECA *is a digital controller that can be used in both open or closed loop. Operation in open and closed loop is also possible. It is mainly destined for OEM application. The programming tool is detachable. Sensor, sensor mounting kit, display are available as options. The unit has to be powered with 24 VDC.*

Specifications

Input power supply	24 VDC ± 5%, 0,2 A
Analogue inputs	
Two analogue inputs	0-10 VDC
Sensor input	Min 4 VDC delta in ± VDC
Analogue outputs	
Two controlled channels	± 10 VDC, 0-20 mA
Open loop signal	0-10 VDC
Digital inputs	
Set point change +	active low
Set point change -	active low
Gain multiplier	active low
Open + closed loop activation	acive low
Output limitation	active low
ABC binary combination	active low
ABC inputs synchronisation	active low
Sensor polarity change	active low
Stop integral term	active low
Digital output	
Sensor level indication	Two binary outputs, active low
Other outputs	
Power supply sensor	± 15 VDC / 100 mA
Voltage reference	+ 10 VDC /10 mA
Options / accessories	
Rotary and linear sensors	see page 34
Programming tool	see page 39
Programming tool and display	see page 39
Window software	see page 39
Terminal mode communication	see page 39
Memory card	see page 39

Features

- ❒ Fully digital, scrolling menu program.
- ❒ Multipurpose application.
- ❒ RS232 communication.
- ❒ Window programming software.
- ❒ Two ouput channels.
- ❒ Automatic sensor scaling.
- ❒ Programmable output configuration.
- ❒ Output sensor information.
- ❒ External set point change.
- ❒ Automatic or imposed PID correction.
- ❒ All features requested for tension control.
- ❒ Plugable memory card.
- ❒ Sensor rescaling without tool.



Warner Electric

CONTROLS

MCS2000-CTDA / CTLC

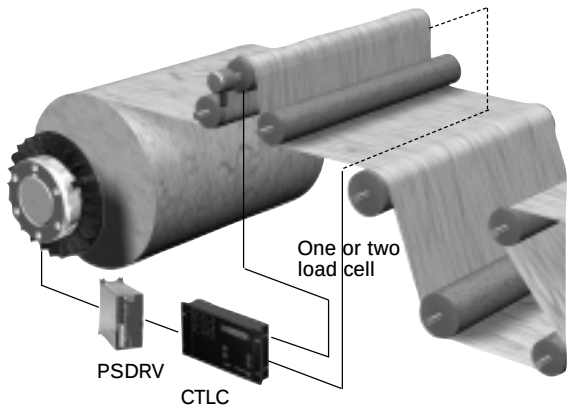
MCS2000-CTDA and CTLC *are packaged versions. Power supply, programming keyboard and display are built in. In the* ***CTLC*** *version (load cell), two load cell amplifiers are installed as standard.*
For both ***MCS2000-CTDA and CTLC*** *two software versions are available. See specifications below.*

Common features of all versions

- ❒ Three mounting possibilities.
- ❒ Software password protected.
- ❒ Fully digital, scrolling menu program.
- ❒ Multipurpose application.
- ❒ RS232 communication.
- ❒ Two ouput channels.
- ❒ Automatic sensor scaling.
- ❒ Programmable output configuration.
- ❒ Output sensor information.
- ❒ External set point change.
- ❒ Automatic or imposed PID correction.
- ❒ All features requested for tension control.
- ❒ Plugable memory card.

Common specifications

Input power supply	110-240 VAC selectable
Analogue inputs	
Two analogue inputs	0-10 VDC
Analogue outputs	
Two controlled channels	± 10 VDC, 0-20 mA
Open loop signal	0-10 VDC
Digital inputs	
Set point change +	active low
Set point change –	active low
Set point change ±	front face switch
Gain multiplier	active low
Output limitation	active low
ABC binary combination	active low
ABC inputs synchronisation	active low
Stop integral form	active low
Digital outputs	
Sensor level indication	Two binary outputs
Other outputs	
Power supply sensor	± 15 VDC / 100 mA ± 5 VDC / 100 mA
Power supply	24 VDC
Voltage reference	+ 10 VDC / 10 mA
Options /accessories	
Memory card	see page 39
Window soft	see page 39
Rotary and linear sensor	see page 34



Various models definitions – specifications – typical applications

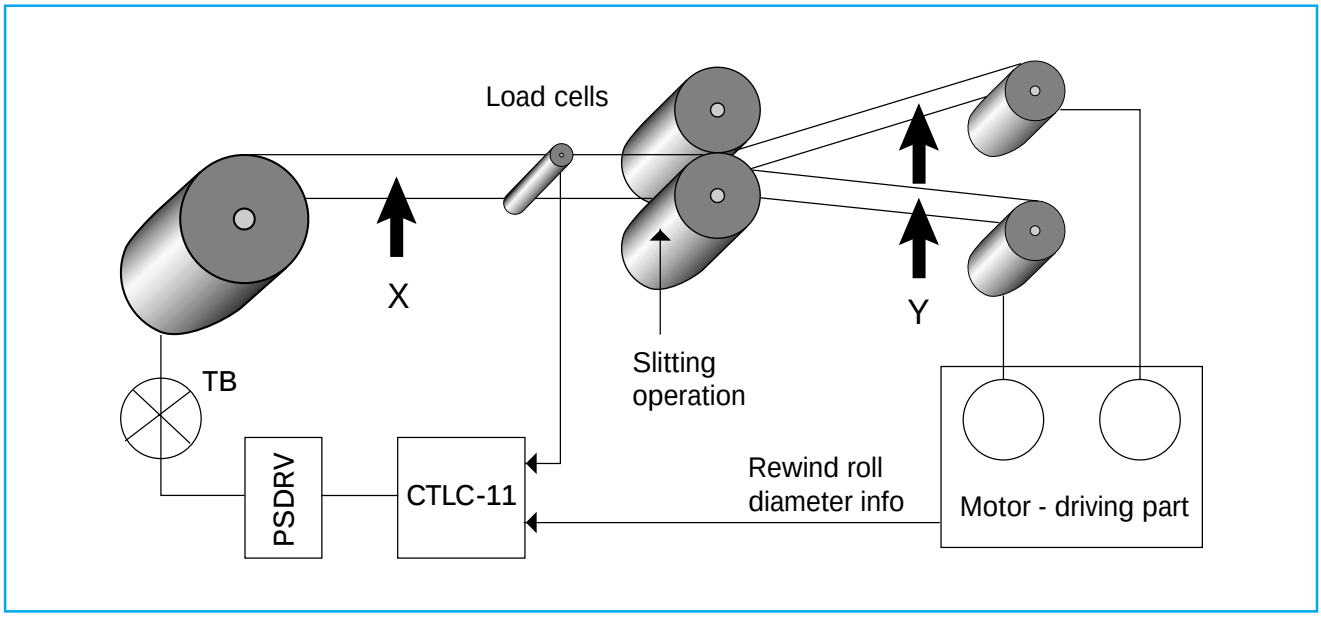
Model	Characteristics	Applications
MCS2000-CTDA-10	RS232 One sensor input	Dancer feedback
MCS2000-CTDA-11	One sensor input Taper position function Limited RS232	Dancer feedback
MCS2000-CTLC-10	RS232 Two scalable sensor input	Load cell feedback
MCS2000-CTLC-11	Two scalable sensor input Taper tension function Limited RS232	Load cell feedback

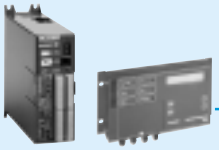
Taper function

The most usual application requiring taper function is the rewind stand where the initial tension on the core has to be automatically reduced as the diameter increases. Rewind diameter information / feedback is essential. The typical application is slitter where no intermediate driving roll is present. The unwind tension, in this case, is the same as rewind and has to be tapered. The tension is identical in zone X and Y.

The tension reference on the controller MCS2000-CTLC-11 is continuously corrected according to the rewind diameter information coming from the driving system or from an ultrasonic sensor measuring the rewind diameter.

The taper function allows a perfect rewind roll shape (mainly avoiding telescopic effect).



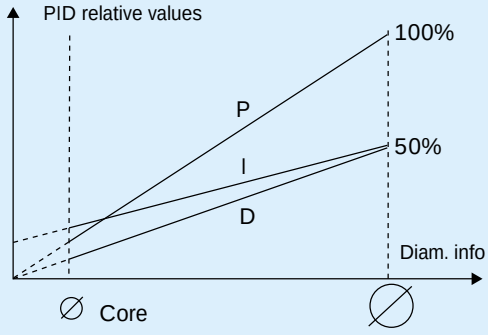


CONTROLS

MCS2000 - Important features

MCS2000 *line is provided with very interesting and useful features. Below is a brief description of the most interesting ones.*

As already stated, the main problem in tension control is the roll inertia change during operation. The PID function is optimal for one inertia value. The MCS2000 line is provided with an important feature which is the PID correction. Based on the available diameter information you can apply a continuous PID correction. When no information is available, an internal PID change can be programmed.



Typical PID values for TB brakes

Each parameter P, I and D can be set individually for the smallest (core) and biggest diameter. As soon as the correct parameters are found for the extreme diameter value, they are stored. The diameter information provided will fix the PID values for the present diameter value. This will allow the system to keep an excellent stability during the whole diameter evolution. In the case where the diameter information is not available we can provide this signal by installing a sonic sensor or by working with internal correction. The external diameter information supplied to the controller will ensure a better precision compensation compared to an internal correction.

WHATEVER YOU NEED MCS2000 CAN REPLY ...

You need the tension control connected to PLC.	⇒	Use RS232 communication.
You need an adaptive PID due to big diameter ratio.	⇒	Use internal or external PID correction. Use RS232 communication to operate the correction.
You already have your own load cell.	⇒	MCS2000-CTLC can accept any signal.
You have flying splice on the machine.	⇒	MCS2000 can manage it.
You need to control a brake and a motor.	⇒	MCS2000 can control both.
You have a multi-material machine range.	⇒	Use memory card to load the correct programme. Use RS232 communication to change the parameters. Use Window software to load the correct programme.
You need taper function.	⇒	Use the right MCS2000 model including this function.
Your feedback is a 0-10 V.	⇒	MCS2000 can accept any signal range.
You need to work in open + closed loop.	⇒	MCS2000 is provided with both function.
You finally found a perfect setting.	⇒	Save it on a memory card as back-up.
You need to display the tension in Newton, kilo…	⇒	MCS2000 can be programmed for any unit.
You have a very special application.	⇒	We can assit you in control definition. Ask Warner representative, we can propose any customised solution / software.

CONTROLS

Open loop control - MCS2000, CTOL-00

MCS2000-CTOL-00 *control is purely dedicated to the open loop control. There are two main uses: diameter calculator and ultrasonic sensor roll measurement. This control can be an alternative where the required tension precision is not critical .*

NEW

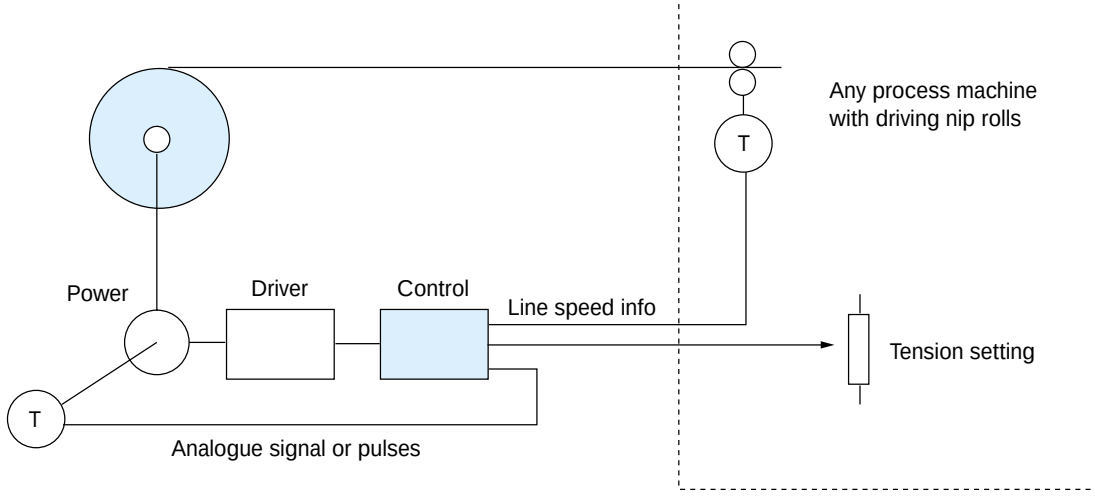
Features

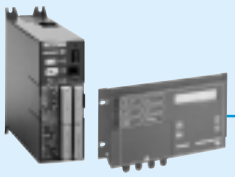
- ❒ Diameter calculator function.
- ❒ Ultrasonic sensor function.
- ❒ DV/dt compensation.
- ❒ Remote tension control.
- ❒ Automatic diameter value store.
- ❒ Master - % slave dual output.
- ❒ Initial reset calculator value.
- ❒ Dynamic friction compensation.
- ❒ Static friction compensation.
- ❒ Fast stop capability.
- ❒ Large 2 x 16 characters display.
- ❒ Taper function for rewind.

Specifications

Input power supply	24 VDC ± 5%, 0,2 A
Analogue inputs	
- Line speed	0-10 VDC
- Rotation speed	0-10 VDC
- Ultrasonic sensor	0-10 VDC
- Torque offset	0-10 VDC
- Torque setting	0-10 VDC
Pulse input for rotation speed	1, 2, 4 pulse/rpm
Analogue outputs	
- Sonic diameter info	0-10 VDC
- Diam. Calcul info	0-10 VDC
- Main output signal	0-10 VDC
- % main output signal	0-10 VDC
Digital inputs	
- Calculator reset	Active low
- Calculator freeze	Active low
- Fast stop	Active low
- Out OFF	Active low
- Out ON	Active low
- Out HOLD	Active low
Digital output	
- Diameter level out	Relay, 24 VDC/0,2 A

Standard application with diameter calculator





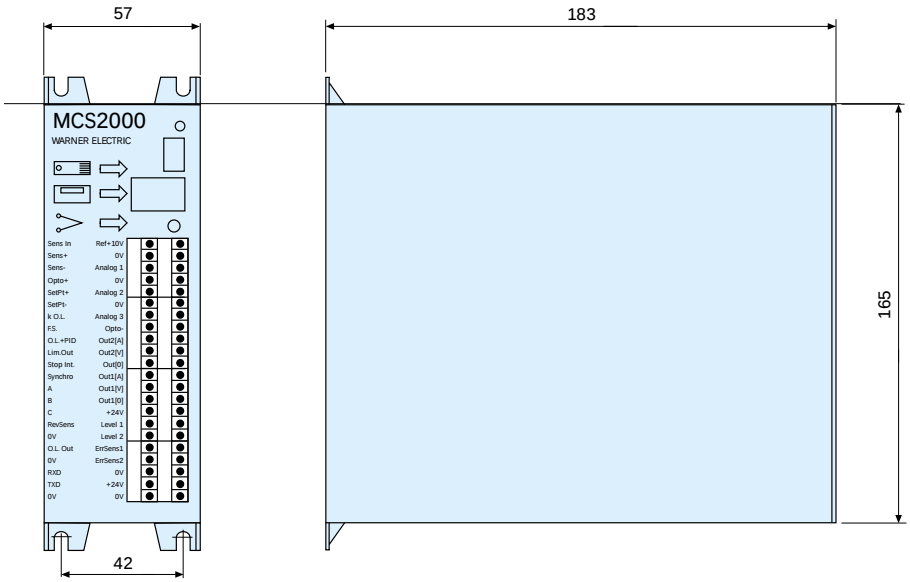
CONTROLS

MCS2000 control line - Dimensions

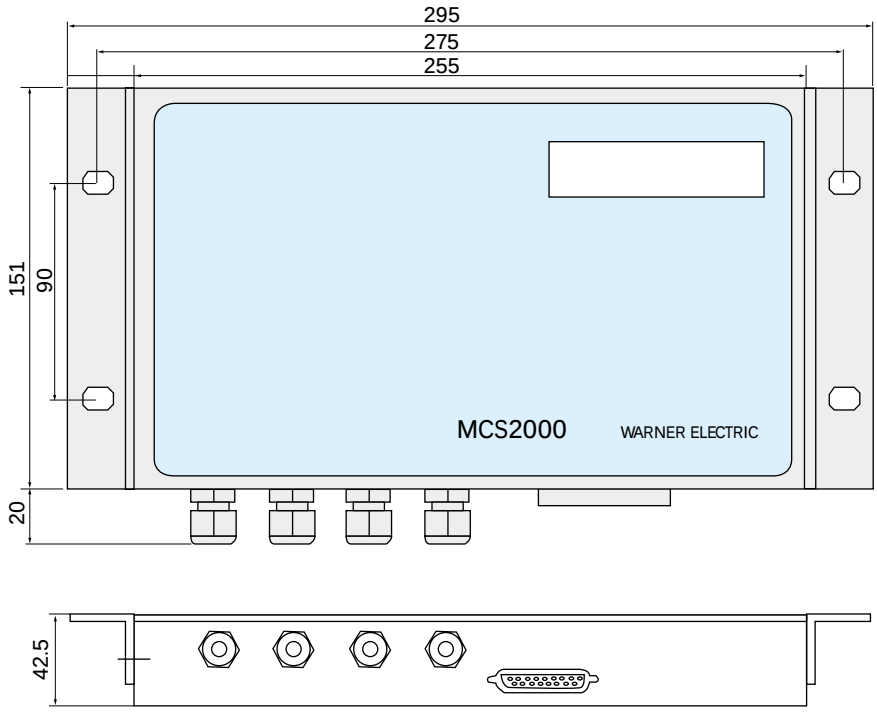
MCS2000-ECA
MCS2000-CTDA-10 / CTDA-11 / CTLC-10 / CTLC-11 / CTOL-00
(same physical dimensions)

Dimensions [mm]

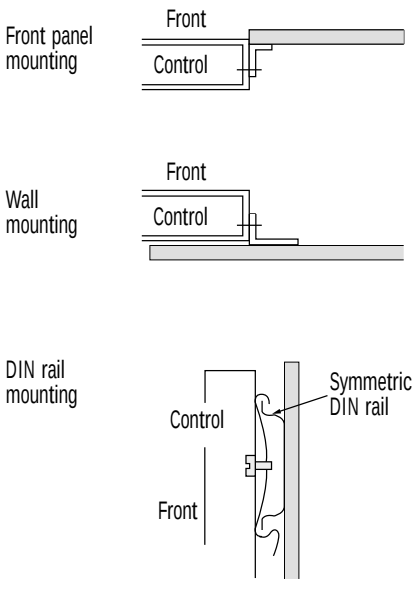
MCS2000-ECA



MCS2000-CTDA, MCS2000-CTLC, CTOL



MOUNTING

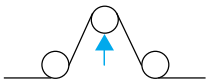
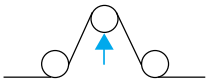
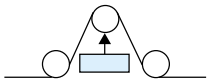
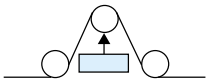
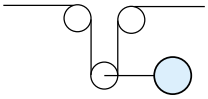
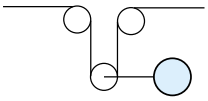
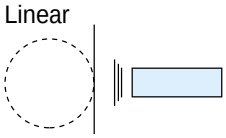
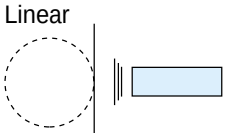
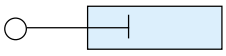


SENSOR ACCESSORIES

Sensors overview

*Working in closed loop requires a web tension **SENSOR**. When working with load cell the system is called "Direct Tension Feedback". When working with dancer arm the system is called "Indirect Tension Sensor". Position sensors are divided in two categories : linear and rotary.*

SENSOR OVERVIEW

MODEL	TYPE / SYMBOL	RANGE	MAIN CHARACTERISTICS	
ES01	End shaft load cell 	❒ 50 N to 2000 N ❒ 6 tension ranges ❒ Resistive bridge	❒ Typical output volltage : 20 mV at full load ❒ 40 mm ball bearing diam.	35
ES02	End shaft load cell 	❒ 250 N to 2000 N ❒ 4 tension ranges ❒ Resistive bridge	❒ Typical output voltage: 20 mV at full load ❒ 52 mm ball bearing diam.	35
FM01	Foot mounted load cell 	❒ 100 to 5000 N ❒ 6 tension ranges ❒ Resistive bridge	❒ Typical output voltage: 5 VDC at full load ❒ Incorporated amplifier	36
FM02	Foot mounted load cell 	❒ 5000 N to 10000 N ❒ 2 tension ranges ❒ Resistive bridge	❒ Typical output voltage : 5 VDC at full load ❒ Incorporated amplifier	36
MCS605-E	Rotary 	❒ ±100° ❒ Resistive conception	❒ Typical output voltage: ± 3.75 VDC for ± 15 VDC power supply and ± 30°	37
MCS705-E	Rotary 	❒ ± 100° ❒ Optical conception	❒ Typical output voltage: ± 3.75 VDC for ± 15 VDC power supply and ± 30°	37
SCUA-030	Linear 	❒ 0 to 1 m ❒ Ultrasonic measure	❒ Typical output voltage: 0-10 VDC for 0 - 1m	38
SCUA-040	Linear 	❒ 0 to 3 m ❒ Two distance ranges ❒ Ultrasonic measure	❒ Typical output : 0-10 VDC for nominal distance	38
MCS905-E	Linear 	❒ 50 mm stroke ❒ Resistive conception	❒ 5-30 VDC power supply Self-aligning bearing 2k resistor	38

DO NOT FORGET: The sensor is the most important element when working in closed loop and has to be accurate, with good repeatability.
- Place load cell in order to measure web tension, minimize the dead load and all other stress interferences on it.
- When using dancer solution create the desired tension with true force (pneumatic cylinder) and not with weight.
- When measuring distance avoid hysteresis in the movement. In general, sensor must be the exact image of the value we have to measure.

SENSOR ACCESSORIES

End shaft load cell type ES

END SHAFT LOAD CELLS *are normally used in new machines designed with the possibility to place the load cell directly on the sensing roll. The end shaft version offers the advantage of being able to easily place the load cell in any tension resultant direction. The* ***ES*** *model exists in two versions differenciated with the diameter of ball bearing which has to be placed in.*

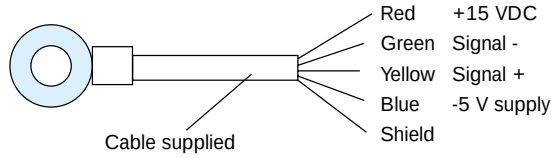
END SHAFT TYPE ES01-...and ES02-...

All end shaft load cells are based on the Wheatstone bridge principle. They have no built in amplifier. They are delivering a signal which is proportionnal to the voltage supply and tension applied. It is important to respect the measurement direction referenced on the load cell body (normally an arrow indicates the sensitive direction).

ES..-... LOAD CELL FEATURES

	ES01-40C and ES02-52C
Power supply	10 to 15 VDC / 40 mA (±5 VDC in Warner control)
Sensitivity	2 mV / V supply at nominal load
	1 mV / V supply for 50 and 150 N models
Rating	50-150-250-500-1000-2000 N
Connections	5 m shielded cable supplied
Mechanical overload	Max 150 % in any direction
Dimensions	See mounting instructions ref. MC481 and MC482
Mounting	See recommendations on page 11

ELECTRICAL CONNECTIONS ES01-... and ES02-...



IMPORTANT:
ES01-40C requires a ball bearing with external diameter 40 mm
ES02-52C requires a ball bearing with external diameter 52 mm

Ball bearing must be self aligning type to allow web tension measurement only (no other external constraints).

AVAILABLE MODELS / CAPACITY

Nominal	50 N	150 N	250 N	500 N	1000 N	2000 N
ES01-...	-50-40C	-150-40C	-250-40C	-500-40C	-1000-40C	-2000-40C
ES02-...	-	-	-250-52C	-500-52C	-1000-52C	-2000-52C

SENSOR ACCESSORIES

Sensors / Accessories

The foot mounted load cell is the ideal solution for machine retrofiting or for heavy tension measurement. The foot mounted model has to be installed with a pillow block type ball bearing supporting the sensing shaft.
FM01-.... *and* ***FM02-....*** *are only differenciated by the physical dimensions.*

FOOT MOUNTED TYPE FM01-…. and FM02-….

Foot mounted load cells are available in two versions:

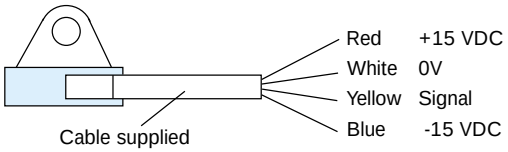
With incorporated amplifier. FM……..-AC Without amplifier. FM……..-C

AC = amplifier and connector on the load cell body. C = connector on load cell body.

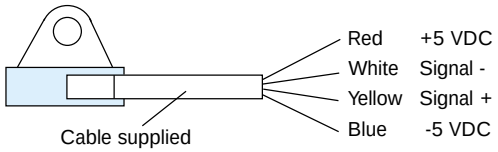
Specifications (all FM SERIES)

	FM……..-AC	FM……..-C
Power supply	±12 to ±15VDC	± 5 VDC or +10 VDC
Sensitivity	0-5 VDC, nominal load	10 mV, nominal load
Rating	100 – 250 – 500 – 1000 – 2500 – 5000 – 10000 Newton	
Connections	Cable supplied, see below	
Permitted overload		
- Compression	150 %	
- Extension	120 %	
Radial permitted force	50%	
Dimensions	See mounting instructions ref. MC480	
Mounting	See recommendations on page 11	

ELECTRICAL CONNECTIONS FM….-AC



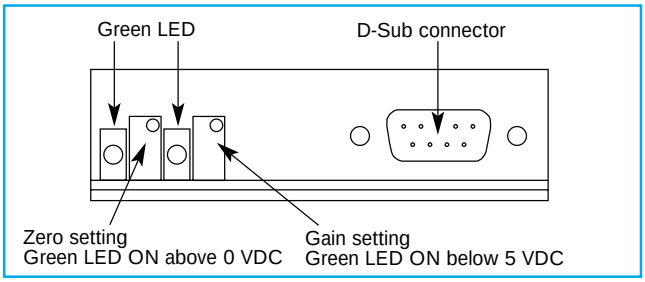
ELECTRICAL CONNECTIONS FM…..C



SETTING (FOR FM…..AC only)

Load cell is factory scaled for:
- No load – 0V output.
- Nominal load – 5V output.

The load cell does not need to be scaled for normal use in closed loop. However, a rescaling after installation is possible by using potentiometer and LED indicators.



AVAILABLE MODELS / CAPACITY

Nominal	100 N	250 N	500 N	1000 N	2500 N	5000 N	10000 N
FM01..-	-100-AC	-250-AC	-500-AC	-1000-AC	-2500-AC	-5000-AC	
FM01..-	-100-C	-250-C	-500-C	-1000-C	-2500-C	-5000-C	
FM02..-						-5000-AC	-10000-AC
FM02..-						-5000-C	-10000-C

SENSOR ACCESSORIES

Rotary sensors

POSITION SENSOR

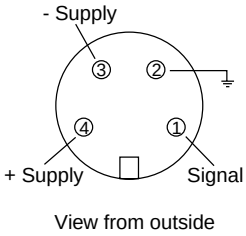
A position sensor is used in 2 possible ways:

- ❒ *To detect dancer moving in the closed loop installation working on dancer principle.*
- ❒ *To sense the diameter of the roll to operate open loop control or make PID compensation in closed loop installation.*

ROTARY SENSOR

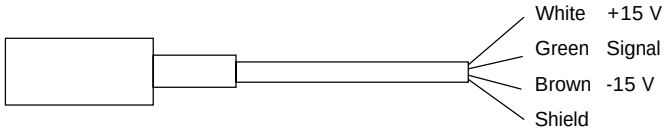
	MCS605-E	MCS705-E
Power supply	10 to 30 VDC / 30 mA (or ± 5 to 15 VDC)	10 to 30 VDC / 30 mA (or ± 5 to 15 VDC)
Max detection angle	200° or ± 100°	200° or ± 100°
Sensitivity	2,5 mV / V / °	
Option : Mounting kit	See page 40	See page 40

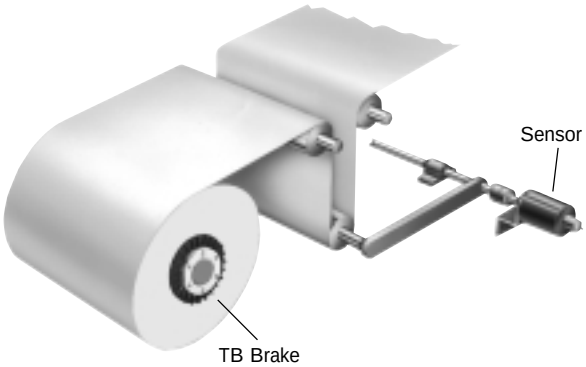
ELECTRICAL CONNECTIONS



View from outside

Cable delivered in mounting Kit option (see page 40).





Working in closed loop with the arm dancer principle is very popular especially in the printing market where a good flexibility of the system is required to absorb the eventual “tension peaks”. The rotary sensor is necessary to read the dancing roll movement.

MCS605-E and MCS705-E are ideal for easy mounting. They are encapsulated in rugged metal housing preventing mechanical shocks. Furthermore they are provided with built in switch in order to change the signal output polarity.

Optional mounting kits facilitating quick and easy fitting on the machine are available. Each kit is composed with brakets, cable, coupling and screws (see page 40).

SENSOR ACCESSORIES

Ultrasonic sensors & linear sensors

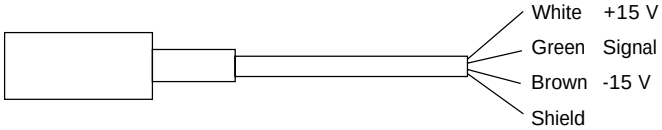
In the tension control market ultrasonic sensors have two primary uses:
- ❒ *For roll diameter reading when the system operates in open loop.*
- ❒ *For loop position reading when the system operates in closed loop with dancer arm principle.*

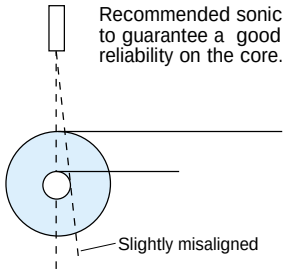
ULTRASONIC SENSORS TYPE SCUA….

	SCUA-030	SCUA-040/080
Power supply	18 to 30 VDC/45 mA	18 to 30 VDC/70 mA
Analogue output	0-10 VDC/ 0 – 1m	0-10 VDC/0-2-3 m.
Digital output	Adj. from 0,15 to 1 m	Adj. from 0,2 to 2,3 m.
Min measure distance	0,15 m	0,2 m
Max measure distance	1 m	2m / 3 m
Housing	Cylindric M18	“Cube”
Accessory	1, 5 m cable delivered	Mounting bracket 3 m cable attached
Option	6 m cable reference : SCUA-032	
Dimensions	See mounting instructions ref. MC485	See mounting instructions ref. MC486

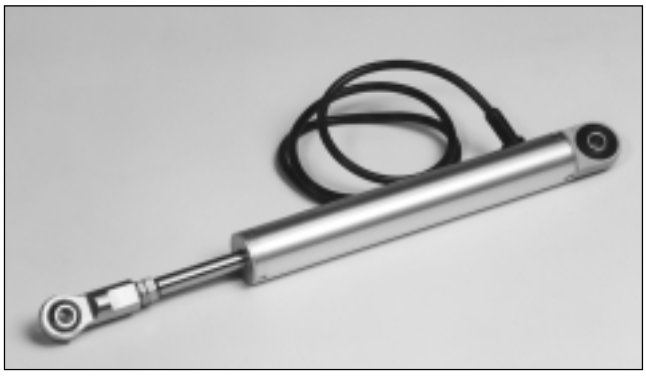
ELECTRICAL CONNECTIONS

Cable with connector for SCUA-030
Cable attached for SCUA-040/080.

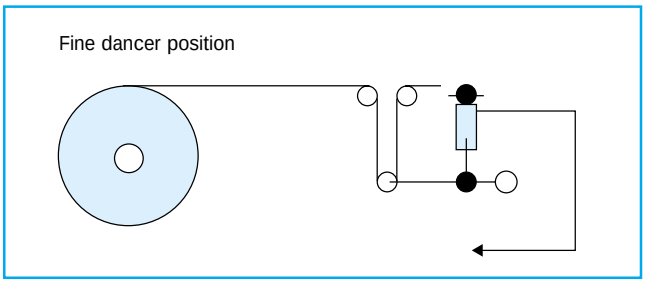




LINEAR RESISTIVE POTENTIOMETER



	MCS905-E
Power supply	5 to 30 VDC
Resistor value	2 K
Electrical stroke	50 mm
Fixation	2 self aligning bearing
Cable	0,5 m attached
- Red and Black	Voltage supply, not polarised
- Yellow	Wipper (output signal)



SENSOR ACCESSORIES

MCS2000 line - Accessories

*All material not entering in the main open or closed loop function is listed in the **ACCESSORY** chapter. This concerns mainly power supply, cable, programming tool, display, amplifier ….*

MCS2000 LINE – ACCESSORIES

	DESIGNATION	MAIN CHARACTERISTICS
MCS2000-PRG 	Hand programmer for MCS2000-ECA.	2 x 16 characters display. Powered from MCS2000-ECA. Connectable and disconnectable during operation. Cable supplied.
MCS2000-CRD 	Memory card for MCS2000-line.	Compatible ECA, CTDA, CTLC. 2 full programmes capacity. Easy load and downloading to control unit. Automatic downloading to control unit. Dimensions : 40 mm x 15 mm.
MCS2000-IS 	Load cells amplifier and Sonic sensor interface. Use as load cells amplifier and adder when two load cells are connected. Can accept any load cell signal comprised between 20 mV and 10 V. Usable as sonic interface for low cost open loop tension control.	Power supply: 24 VDC ± 10%, 300 mA Input load cells: 2 inputs - from 2m mV to 10 V / 5 K Input sonic: 1 input – delta voltage min 2 V Other inputs: 0-10 VDC / 10 K Signal output: 2 ouputs – 0-10 VDC Power output: ± 5 or 15 VDC to power load cells +24 VDC to power sonic.
MCS2000-DP 	Pannel mounted programmer + display for MCS2000-ECA . (Same characteristics as MCS2000-PRG but designed for panel mounting).	2 x 16 characters lines display. Powered from the MCS2000-ECA.
MCS2000-PS 	24 VDC power supply unit.	Power supply: 100 –250 VAC autoranging Output: 24 VDC ± 5%, 3,1 Amps
MCS2000-PLC	List of codes available on request.	RS232 communication for MCS2000 line.
MCS2000-WIN 	3 diskettes or E-mail transmittable.	Compatible Window 95 - 98. To programme MCS2000 control line.

SENSOR ACCESSORIES

Rotary sensors - Accessories

MCS2000 *product line supports RS232 communication. Every unit of the line can be connected to a PLC in terminal mode or / and programmed with PC.*
Using terminal mode requires various codes to transmit to the unit. Using the PC to programme the unit requires installation of Warner Electric software (windows compatible). Both options are available.

MCS605-E - ACCESSORIES

The MCS202-Exx is designed to work with dancer arm principle. Usually the sensor is a rotary type.

Warner sensor MCS605-E and MCS705-E can be delivered with complete mounting kit.

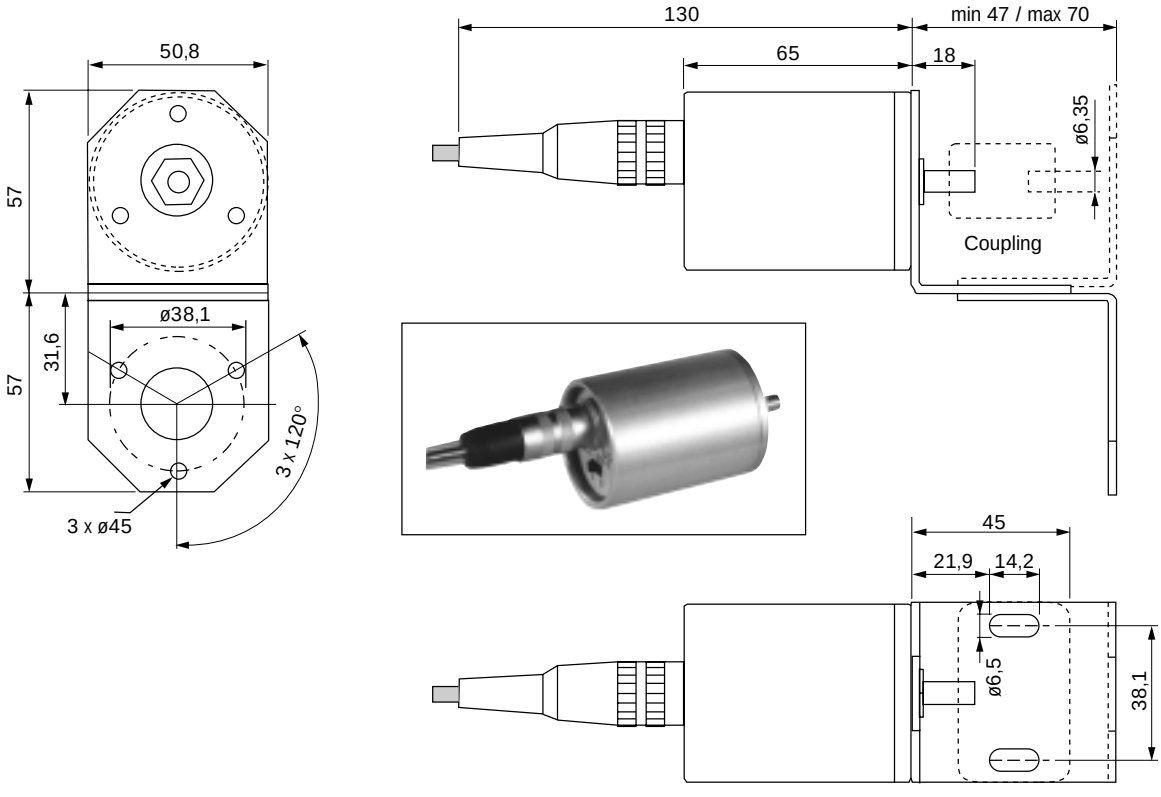
Mounting kit comprises of CABLE, COUPLING, BRAKETS and all necessary SCREWS. Various KITS are differenciated with various length of cable and cable with or without connector at control end side.

MCS2000 line requires free leads (MCS2000 control line is provided with terminal block).

MCS202-Exx requires a connector (MCS202-Exx is provided with the connector).

	Cable length	One / Two connectors	Compatible
MCS-KIT1	3 m	2	MCS202-Exx
MCS-KIT2	3 m	1	MCS2000
MCS-KIT3	4,5 m	2	MCS202-Exx
MCS-KIT4	4,5 m	1	MCS2000
MCS-KIT7	6 m	2	MCS202-Exx
MCS-KIT8	8 m	1	MCS2000

DIMENSIONS - MOUNTING

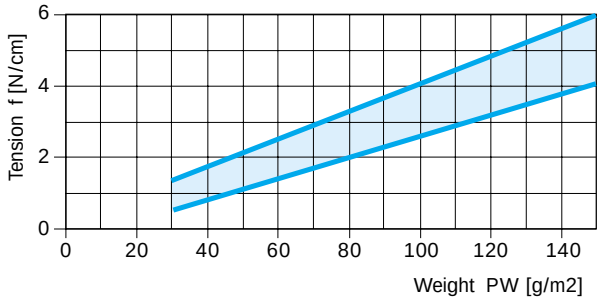


Tension selection

*The **WARNER ELECTRIC** experience enables us to offer a tension guide as shown below. For any special material not included in the chart below, please consult **WARNER .***

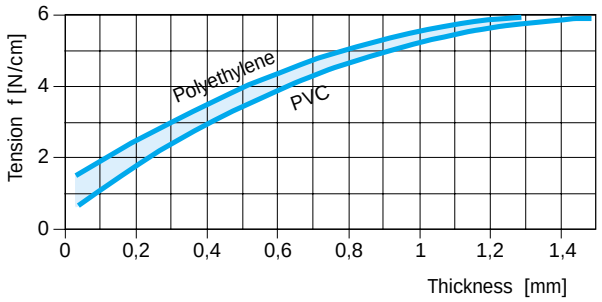
PAPER WEIGHT

F = f x width [cm]

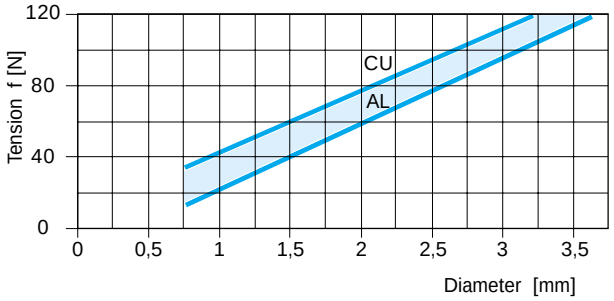


FOIL

F = f x width [cm]



WIRE



MATERIAL DENSITY

	kg/m³
Paper	920
Paper board	1420
Alu foil	2720
Alu wire	2750
Cu wire	8550
PVC	400-1050

Data application Form

To enable us to assist you in selecting the best product type and specification to ensure reliable and accurate tension control, please submit this ***APPLICATION FORM.***

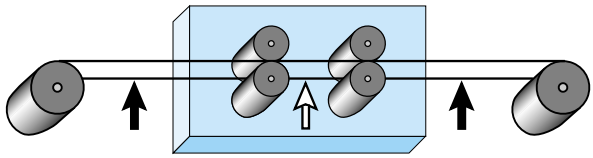
Company name: _____

Adresse: _____

City: _____ Country: _____

Contact name: _____ Phone / fax: _____

e mail: _____



		Unwider stand	Nip roll	Rewind stand
Which type of machine is it ?				
♦ Printer, Slitter, Sheeter, Coater, Laminator, …or other ?				
Which machine part concerned				
Which web material is it ?				
Max / min tension (if known)				
Characteristics of the material				
♦ Paper weight	Gr / m²			
♦ Plastic film thickness	mm			
♦ Wire diameter, matter	mm			
♦ Other (short description)				
Characteristics machine				
♦ Auto flying splice	Yes / No			
♦ Zero speed splice	Yes / No			
♦ Max linear speed	M / min			
♦ Min linear speed	M / min			
♦ Max acceleration time	M / min / sec			
♦ Normal deceleration time	M / min / sec			
♦ Emergency stop time	M / min / sec			
♦ Taper tension requested	+ or - %			
Roll characteristics				
♦ Weight	Kg			
♦ Max diameter	mm			
♦ Min diameter	mm			
♦ Max width	mm			
♦ Min width	mm			
General information				
♦ Is it a new project or a retrofit ?				
♦ Loosing tension permitted in emergency stop case	Yes / No			
♦ If machine working in cycle, what's the cycle rate ? Speed in m/min	Time in sec.	Speed / Max speed / Time		
♦ Is the brake or motor direct on shaft or gear mounted ?	Roll/ brake (rpm)			
♦ Which brake or motor technology ?	Electromagnetic brake Motor			
♦ Which control configuration ?	Open loop / Closed loop			

Please complete this form as much as possible. Please also include any other information of interest.

Warner Electric