

# Digital Tapchanger Control M-2001C

Digital Tapchanger Control for  
Transformers and Regulators



*Comprehensive Model Shown*

- LTC transformer, substation regulator, and line regulator control provides reliable operation with expanded capabilities
- Available in four models: Comprehensive, Base-T, Base-RS, and Base-R
- Adapter panels to retrofit popular industry tapchanger controls
- Ten on-board communication protocols
- Count Window - Works even with noisy operation counter contacts
- Field-updatable programming
- Reverse power detection/operation
- Demand metering/Data Logging with Date/Time Stamp
- Entire control configuration prints out from TapTalk®
- SCAMP™ (SCADA Controllable Auto/Manual Pushbutton) Adapter Panel Auto/Manual Switch State can be changed by a SCADA command pushbutton
- Overcurrent protection
- SCADA Heartbeat
- Manual Heartbeat Timer
- LDC with R & X or Z-compensation
- Adjustable 10 Volt Bandwidth
- Optional Ethernet port
- Supports terminal mode for modem communications in TapTalk
- Transformer paralleling by circulating current, external master-follower circuitry, or ΔVAR® methods
- Standard LCD display (rated -20 to +70 degrees Celsius), Optional Vacuum Fluorescent display (rated -40 to +80 degrees Celsius)
- Optional Control Power Backup Input for Fiber Optic loop-through communication
- M-2829 TapPlot® Analysis Software allows plotting, printing, and analysis of Tap Information



The M-2001C Tapchanger Control is available in four models: Comprehensive, Base-T, Base-RS and Base-R.

- The **Comprehensive** model includes all M-2001C features and can be used for LTCs or regulators where SCADA communications are desired.
- The **Base-T** model is designed for Transformers. It uses one COMM port (COM2) for communications.
- The **Base-RS** model is designed primarily for Regulators, but can also be applied to LTCs where SCADA communication is required. It provides one COMM port (COM2) and one SCADA COMM port (COM1), available as either an RS-485 or as a Fiber Optics port for communications.
- The **Base-R** model is designed primarily for Regulators, but can also be applied to LTCs where no SCADA communication is required. It uses one COMM port (COM2) for communications.

### The following features are Standard on ALL M-2001C models:

#### Features

- VT Ratio Correction
- CT to VT Phasing Correction
- Three Independent Voltage Reduction Steps
- Reverse Power Operation, for Transformer LTC and Single-Phase Regulator applications
- Selectable Outputs, Continuous or Pulsed
- Intertap Time Delay
- Drag Hands Operation
- Tap Position Record
- Adjustable Line Overcurrent Tapchange Inhibit
- A or B Regulator Type Selection
- Operations Counter
- Resettable Operations Counter
- Auto / Off / Manual Switch Status

#### Control Setpoints

- Adjustable Bandcenter
- Adjustable Bandwidth
- Line Drop Compensation (R,X or Z)
- Time Delay (Definite or Inverse)
- Voltage Limits and Runback
- Tap Position Limits

#### Monitoring & Metering

- Real-Time Metering of measured and calculated parameters
- Demand Metering with selectable time interval
- Harmonic Analysis through TapTalk

#### Inputs & Outputs

- Control Voltage Input
- Motor Power Input
- Line Current Input
- Raise Output / Lower Output
- Seal-in Output
- Voltage Reduction 1 & 2 Inputs (Binary)
- Neutral Position Detect (Binary)
- Counter Input (Binary)
- Seal-in / Switch Status Input (Binary)

#### Front Panel

- 20 Character by 2 Row LCD Display
  - Ten Front Panel **LEDs**:
    - **RAISE** – Out-of-Band
    - **LOWER** – Out-of-Band
    - **REV PWR** – Reverse Power Flow detected
    - **OK** – CPU Check
    - **LDC** – Line Drop Compensation in effect
    - **V/RED** – Voltage Reduction in effect
    - **MANUAL** – Auto Operation Blocked
    - **LOCAL\*** – SCADA Control Blocked
    - **TX / RX\*** – COM1 Transmitting/Receiving
- \*Not functional on Base-T and Base-R

#### Communications

- M-2029A TapTalk Communications Software
- M-2829 TapPlot Tap Analysis Software
- Front RS-232 Communications Port COM2
- BECO 2200 protocol on COM2 Port

<b>MODEL-SPECIFIC FEATURES, OPTIONS, AND ACCESSORIES</b>				
N/A = Not Available				
<b>FEATURE</b>	<b>COMP</b>	<b>Base-T</b>	<b>Base-RS</b>	<b>Base-R</b>
Sequential and Non-Sequential Operation	✓	✓	✓	N/A
Sequential Operation ONLY	N/A	N/A	N/A	✓
Alarm Contact Outputs (2):	✓	✓	N/A	N/A
Self-Test Alarm Output Contacts	✓	✓	✓	N/A
User Programmable Alarm Contacts	✓	✓	N/A	N/A
Tap Position Knowledge by:				
Motor Direct Drive KeepTrack	✓	✓	✓	✓
Contact KeepTrack, Shaft Coupled KeepTrack, Resistor Divider KeepTrack	✓	✓	N/A	N/A
Adapter Panel Auto/Manual Switch Type Selection	✓	N/A	✓	N/A
External Inhibit of Auto Tapchange (non-sequential)	✓	✓	N/A	N/A
Circulating Current Input	✓	✓	N/A	N/A
Circulating Current Paralleling Method	✓	✓	N/A	N/A
Non-Sequential / SCADA Block Input (Binary)	✓	N/A	✓	N/A
<b>COMMUNICATIONS</b>				
COM1 (top of control) RS-232, RS-485 and Fiber Optics	✓	N/A	N/A	N/A
<b>Optional</b> Ethernet Port COM3 (RJ-45, 10 Mbps) supports: DNP / BECO 2200 / MODBUS over TCP/IP	✓	N/A	N/A	N/A
<b>Optional</b> COM1 Port: RS-485 or Fiber Optics	N/A	N/A	✓	N/A
Communication Protocols include: BECO 2200, BECO 2179, Cooper 2179, Cooper 2179A, GP-2179, GP DNP3.0, DNP3.0, AL PWR DNP3.0, MISS PWR DNP3.0, and MODBUS	✓	N/A	✓	N/A
SCADA Heartbeat / SCADA Manual Heartbeat Timer	✓	N/A	✓	N/A
<b>OPTIONAL FEATURES</b>				
Vacuum Fluorescent Display (rated -40 to +80° C)	✓	✓	✓	✓
ΔVAR Paralleling Methods	✓	✓	N/A	N/A
Control Power Back-Up Input: (+12 Vdc) for backup of Fiber Optic loop-through communication	✓	N/A	✓	N/A
<b>OPTIONAL ACCESSORIES</b>				
M-2026 AC-DC Control Power Backup Supply	✓	✓	✓	✓
M-2027 Control Power Backup Supply - AC Only	✓	✓	✓	✓
M-2025B(D) Current Loop Interface Module: Current-to- Voltage analog converter for Tap Position Sensors	✓	✓	N/A	N/A
M-2948 Tap Position Sensor	✓	✓	N/A	N/A

## Features

■ **NOTE:** Product features are based on the M-2001C Model and the Options purchased.

**Bandcenter:** Adjustable from 100 V to 135 V in 0.1 V increments.

**Bandwidth:** Adjustable from 1 V to 10 V in 0.1 V increments.

**Line Drop Compensation:** R and X compensation. Adjustable from -24 V to +24 V in 1 V increments. Z compensation available with adjustment of voltage raise from 0 V to +24 V, in increments of 1 V.

**Time Delay:** Definite; adjustable from 1 second to 120 seconds, in 1 second increments. Inverse; adjustable from 1 second to 120 seconds, in 1 second increments.

**InterTap Time Delay:** Used to introduce time delay between tap operations when control is in sequential mode; adjustable from 0 to 60 seconds in 1.0 second increments. Counter input required.

**Selectable Outputs:** Continuous or pulsed. Normally, an output (raise or lower) signal is maintained when the voltage remains outside the band. A pulsed output length is programmable from 0.2 to 12 seconds, in increments of 0.1 second.

### Reverse Power Operation:

**Transformer LTC Application:** Can be set to Block, Ignore, Return to Neutral, or Distributed Generation. The Return To Neutral setting requires positive tap position knowledge. Select the applicable method of tap position knowledge from the "Tap Information" screen.

**Single-Phase Regulators:** Can be set to Block, Ignore, Regulate Reverse, Return To Neutral, or Distributed Generation. The Return to Neutral or Regulate Reverse setting requires positive tap position knowledge. Select the applicable method of tap position knowledge from the "Tap Information" screen. The Regulate Reverse feature allows separate setpoints and regulation in the reverse direction without the installation of source-side VTs.

**CT to VT Phasing Correction:** Adjustable from 0° to +330° in 30° increments.

**Real-Time Metering:** The following measured and calculated values are available in real-time:

- Local Voltage
- Load kVA, or MVA
- Load Center Voltage (Compensated Voltage)
- Load kW, or MW
- Line Current
- Load kVA, or MVA
- Power Factor
- Line Frequency

**Demand Metering:** Time interval selected as 15, 30, or 60 minutes.

### Drag Hands Operation:

The following "drag-hand" values are stored with date and time stamping and are averaged over 32 seconds:

- Minimum Local Voltage
- Maximum Local Voltage

The following "drag-hand" values are stored with date and time stamping and are calculated over the demand time interval (15, 30, or 60 minutes) as selected by the user:

- Maximum Primary Line Current
- Maximum Load kW, or MW
- Maximum Load kVA, or MVA
- Maximum Load kVA, or MVA (and Power Factor at time of Maximum Load kVA, or MVA)

**Line Overcurrent Tapchange Inhibit:** Adjustable from 200 mA to 640 mA of line current for 200 mA CT or 1.0 A to 3.2 A for 1 A CT display and 5.0 A to 16.0 A for 5 A CT display. External auxiliary CT required for 1.0 A and 5 A CT inputs.

**Voltage Limits, Tap Position Limits, and Runback:** Overvoltage and Undervoltage limits are independently adjustable from 95 V to 135 V in 0.1 V increments. Upper and lower tap position limits may be set by user, with tap position knowledge active. An adjustable deadband (above the overvoltage limit) of 1 V to 4 V is available, which is used to set the runback limit.

**Voltage Reduction:** Three independent steps, each adjustable from 0% to 10% in 0.1% increments of the bandcenter setpoint. Also included is a Voltage Reduction Turn Off Timer feature that when the timer is set from 1 to 999 minutes (0 minutes = disabled), it will turn off any Voltage Reduction invoked (via Comms) after the time expires.

**Inhibit of Auto Tapchange:** Blocks automatic tapchanger operation in response to external contact closure or software setting.

**Sequential or Non-Sequential Operation:** Non-sequential operation resets the time delay upon momentary external contact closure at the non-sequential input.

#### **Paralleling Methods:**

**Circulating Current:** The circulating current method is standard, and may be implemented using separate balancing equipment such as the Beckwith Electric M-0115A Parallel Balancing Module. Consult with factory for use with existing external master-follower circuitry.

**$\Delta$ VAR:** The  $\Delta$ VAR1 method may be implemented by using separate balancing equipment such as the M-0115A Balancing Module. The  $\Delta$ VAR2 method does not require the use of the M-0115A Balancing Module and is only applicable when paralleling two transformers.

For all methods of paralleling except  $\Delta$ VAR2, overcurrent protection, such as that provided by the M-0127A Overcurrent Relay, is recommended.

**VT Ratio Correction:** VT correction from -15 V to +15 V in 0.1 V increments.

**Self-Test Alarm Output Contacts:** Alerts operator to loss of power or malfunction of control. When the control is configured for SCAMP Pushbutton Auto/Manual Switch Type, this output is not available.

**User-Programmable Alarm Contacts:** Alerts operator to one or more of the following system conditions: Communications Block Invoked, Block Raise Voltage Limit Exceeded, Block Lower Voltage Limit Exceeded, Voltage Reduction (any step) Invoked, Reverse Power Flow Condition Detected, Line Current Limit Exceeded, Tap Block Raise in Effect, and Tap Block Lower in Effect.

#### **Tap Position Knowledge**

**Transformer LTC:** The optional M-2025B(D) Current Loop Interface Module receives a tap position signal from a tap position sensor (M-2948) or Incon 1250B Rotary Position Sensor and outputs to the M-2001C through a bottom port.

**Single-Phase Regulators:** In most applications, tap position information can be maintained by means of Motor Direct Drive KeepTrack logic.

**Operations Counter:** A software counter increments by one count per either an open/close/open contact operation (X1) or an open/close or close/open contact operation (X2), and is preset by the user. A count window mode registers any activity as a valid input within the count window time setting.

**Resettable Operations Counter:** A second software counter, similar to the operations counter, which may be reset by the user.



**Harmonic Analysis:** Provides the total harmonic distortion and the harmonic content of the load voltage and current up to the 31st harmonic (using TapTalk with BECO 2200 protocol).

**Tap Position Record:** Provides a record of the number of times each tap position has been passed through (using TapTalk with BECO 2200 protocol). The tap position record can be reset by the user.

**Auto/Manual Switch Status:** Provides the user with the Auto/Manual switch position status through the Comm ports. When the M-2001C is configured for a switch status input, the switch status is read using the seal-in input on the control. When configured for Seal-in INPUT, the switch status is read using the counter INPUT.

**A or B Regulator Type:** Allows the user to select the type of regulator being used to provide a more accurate source voltage calculation.

**SCADA Heartbeat:** The purpose of the SCADA Heartbeat feature is to have two sets of settings for the control and switch between these two setting sets based on the presence or absence of SCADA communications (utilizing the DNP protocol) to the control. The SCADA Heartbeat feature can be enabled from TapTalk Communications software. There are two different types of SCADA Heartbeat modes that can be selected:

- SCADA Heartbeat (LTC) for transformer control applications
- SCADA Heartbeat (Regulator) for regulator control applications

**Manual Heartbeat Timer:** The Manual Heartbeat Timer feature provides a method to place the control in Heartbeat Manual operation (implemented from Comms only) and automatically place the control back in Auto mode based on a Timer setting (settable only via Comms).

### Inputs

**Control Voltage Input:** Nominal 120 Vac, 60 Hz (50 Hz optional); operates properly from 90 Vac to 140 Vac. If set at 60 Hz, the operating system frequency is from 55 to 65 Hz; if set at 50 Hz, the operating system frequency is from 45 to 55 Hz. The burden imposed on the input is 8 VA or less. The unit should be powered from a voltage transformer connected at the controlled voltage bus. The unit will withstand twice the voltage input for one second and four times the voltage input for one cycle.

**Motor Power Input:** Nominal 120 Vac to 240 Vac, at up to 6 A as required by the load, with no wiring changes required.

**Line Current Input:** Line drop compensation is provided by a current transformer input with a 0.2 A full scale rating. A Beckwith Electric model M-0121 (5 A to 0.2 A) or M-0169A (5 A or 8.66 A to 0.2 A) Auxiliary Current Transformer is available when required. The burden imposed on the current source is 0.03 VA or less at 200 mA. The input will withstand 480 mA continuous and 4 A for 1 second.

**Circulating Current Input:** Parallel operation of regulators or transformers is accommodated by a current transformer input with a 0.2 A full scale rating. The burden imposed on the current source is 0.03 VA or less at 200 mA. The input will withstand 300 mA continuously, 400 mA for two hours, and 4 A for 1 second.

**Control Power Backup Input** (Two pin Molex connector on the top of control): The Control Power Backup Input feature when connected to either a M-2026 or M-2027 backup power supply sustains operation of the control in the event of a loss of AC input power to the control. Raise and Lower commands are possible if the control's motor power remains energized. See **M-2026/M2027 Control Power Backup Supplies** ([page 17](#)).

## Binary Inputs

**Voltage Reduction 1 & 2 Inputs:** These inputs provide three levels of programmable voltage reduction which can be manually invoked.

**Neutral Position Detect:** The Neutral Position Detect Input detects the neutral tap position, which assists the KeepTrack tap position function. This Neutral Position Detect Input also facilitates disabling the paralleling mode  $\Delta$ VAR2.

**Counter Input/Switch Status Input:** When Input Selection 1 configuration is set to Switch Status, the Counter Input detects tap position changes and updates two counters, one pre-settable and one re-settable. When Input Selection 1 configuration is set to Seal-In, the counter input is used as the Switch Status Input and the Seal-In input will cause the counter to increment.

**Seal-in/Switch Status Input:** When the Input Selection 1 configuration is set to "seal-in input", this input provides for detection of the seal-in state to operate the seal-in output and will also increment the counters. When "Input Selection 1" is set to Switch Status Input, this input provides the means to read the Auto/Manual switch position status using SCADA.

**Non-Sequential/SCADA Cutout Input:** When the Input Selection 2 configuration is set to "Nonseq Input", this input provides the means to perform non-sequential operations. When Input Selection 2 is set to "SCADA Cutout Input", this input provides a means to block all write operations to the control from SCADA.

## Outputs

**Raise Output:** Capable of switching 6 A at 120 Vac to 240 Vac motor power.

**Lower Output:** Capable of switching 6 A at 120 Vac to 240 Vac motor power.

**Seal-In Output:** Connects to the B-0553 or B-1711 motor seal-in printed circuit board subassembly.

**Deadman Alarm Output:** Capable of switching 6 A at 120 Vac or 100 mA at 120 Vdc.

**Programmable Alarm Output:** Capable of switching 3 A at 120 Vac or 100 mA at 120 Vdc.

## Front Panel Controls

Menu-driven access to all functions by way of four pushbuttons and a two-line alphanumeric display. There are two programmable passwords available to provide various levels of access to the control functions.

The M-2001C offers a 2-line by 20 character LCD display for enhanced viewing in direct sunlight. It also offers a low-level LED backlight for reading in darker environments. An optional 2-line by 20 character Vacuum Fluorescent Display (VFD) is available for industrial temperature range operations (-40° C to +80° C).

## LED Indicators

Front panel LED indicators show the following control conditions: Out-of-Band **RAISE**, Out-of-Band **LOWER**, Reverse Power Flow **REV PWR** detected, CPU **OK**, Line Drop Compensation **LDC** IN EFFECT, Voltage Reduction **V/RED** IN EFFECT, Communications or Front Panel Auto Operation Block **MANUAL**, **SCADA** control blocked **LOCAL** and **COM1 TX** and **RX**.

## Output Contacts

**Alarm Contact Outputs (2):** One normally open programmable contact capable of switching 3 A at 120 Vac and one normally closed self-test alarm contact; capable of switching 6 A at 120 Vac.

## Voltage Measurement Accuracy

Control accuracy is  $\pm 0.3\%$  when tested in accordance with the ANSI/IEEE C57.15.9-1999 standard over a temperature range of  $-30^{\circ}\text{C}$  to  $+65^{\circ}\text{C}$ . The control accuracy is  $\pm 0.5\%$  when tested over the full operational temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

## Communications

The communication ports provide access to all features, including metering, software updates, and programming of all functions. This is accomplished using a modem or direct serial connection from any Windows based computer running the TapTalk Communications Software package or SCADA communications software. COM1 (top) is available with RS-232, RS-485 or Fiber Optics. COM3 is an optional RJ45 Ethernet Port. COM2 is an RS-232 front port for local communications with TapTalk BECO 2200 and for software updates.

**Protocols:** The following standard protocols are included in COM1/COM3: BECO 2200, BECO 2179, Cooper 2179, Cooper 2179A, GP 2179, GP DNP3.0, AL PWR DNP3.0, MISS PWR DNP3.0, DNP3.0, and MODBUS. COM2 uses BECO 2200 for local communications.

**Communications Via Direct Connection:** TapTalk supports direct communication with a Beckwith Electric M-2001C Digital Tapchanger Control using a serial "null modem" cable with a 9-pin connector (DE9P) for the control, and the applicable connector (usually DE9S or DB25S) for the PC, or Fiber Optic communication using ST standard or two-wire RS-485.

**Optional:** An optional ethernet 10 Mbps port (COM 3) is available (Comprehensive Version only) through an RJ-45 jack on the top of the control. This port supports DNP over TCP/IP, BECO 2200 over TCP/IP, and MODBUS over TCP/IP protocols.

**Application:** Using a PC, the operator has real-time, remote access to all functions of the M-2001C Digital Tapchanger Control. The control can act as the monitoring point for all voltage, current, and related power quantities, thereby simplifying operation while avoiding transducers and multiple Remote Terminal Unit (RTU) analog inputs. The protocols implement half-duplex, two-way communications. This allows all functions, which would otherwise require the presence of an operator at the control, to be performed remotely. Communication capabilities include:

- Interrogation and modification of setpoints
- Broadcast of commands, such as tap change inhibit and voltage reduction (up to three steps) to networked controls
- Recognition of alarm conditions, such as voltage extremes and excessive load
- Selective control of raise and lower tap change operations
- Re-configuration of the control, such as a change to the demand integration time period or a selection of different alarm parameters

**Unit Identifier:** A 2-row by 15-character alphanumeric sequence, set by the user, can be used for unit identification.



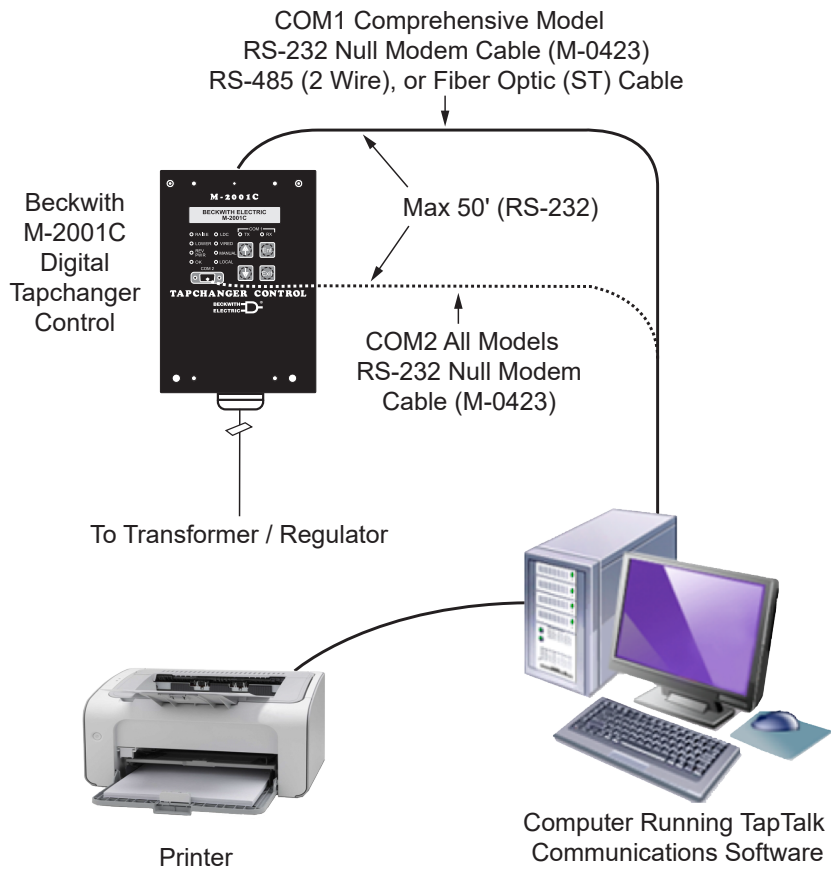


Figure 1 Direct Connection

**Communications Using a Modem:** TapTalk supports remote (modem) communications with a Beckwith Electric M-2001C Digital Tapchanger Control (COM1 or COM2, COM1 shown). A Hayes-compatible modem and proper cabling is required.

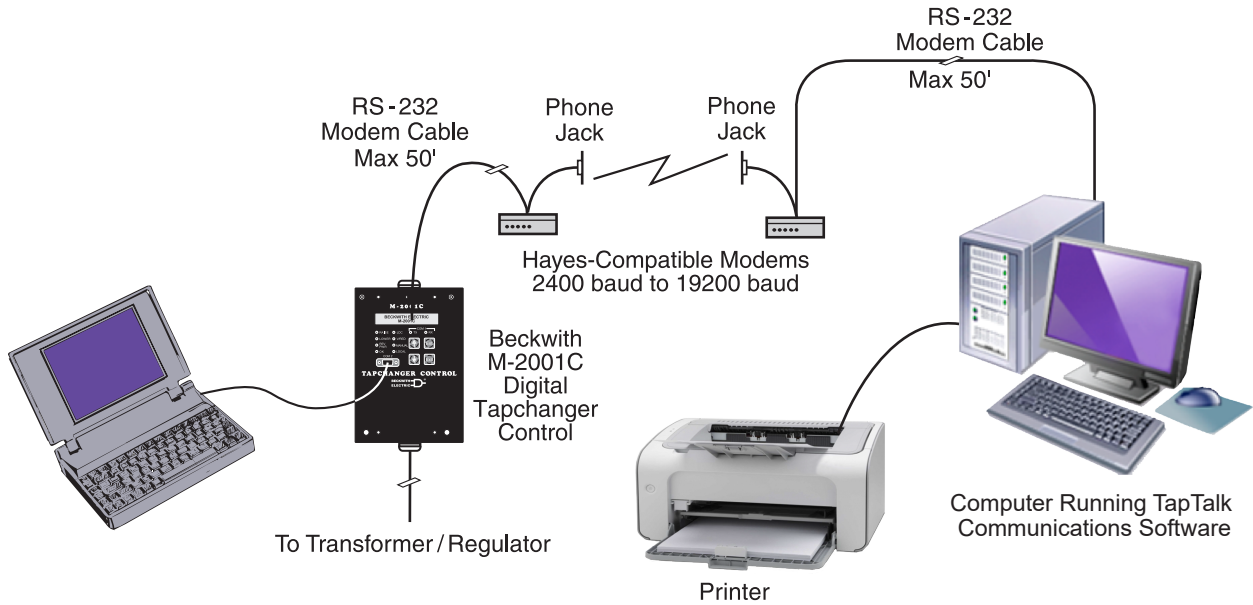


Figure 2 Modem Connection

**Communications Using Networking:** The addressing capability of TapTalk allows networking of multiple Beckwith Electric digital tapchanger controls (COM1 or COM2, COM1 shown). Each tapchanger control can be assigned an address ranging from 1 to 200. Selected commands may be broadcast to all controls on the network. [Figure 3](#) through [Figure 5](#) illustrate typical network configurations.

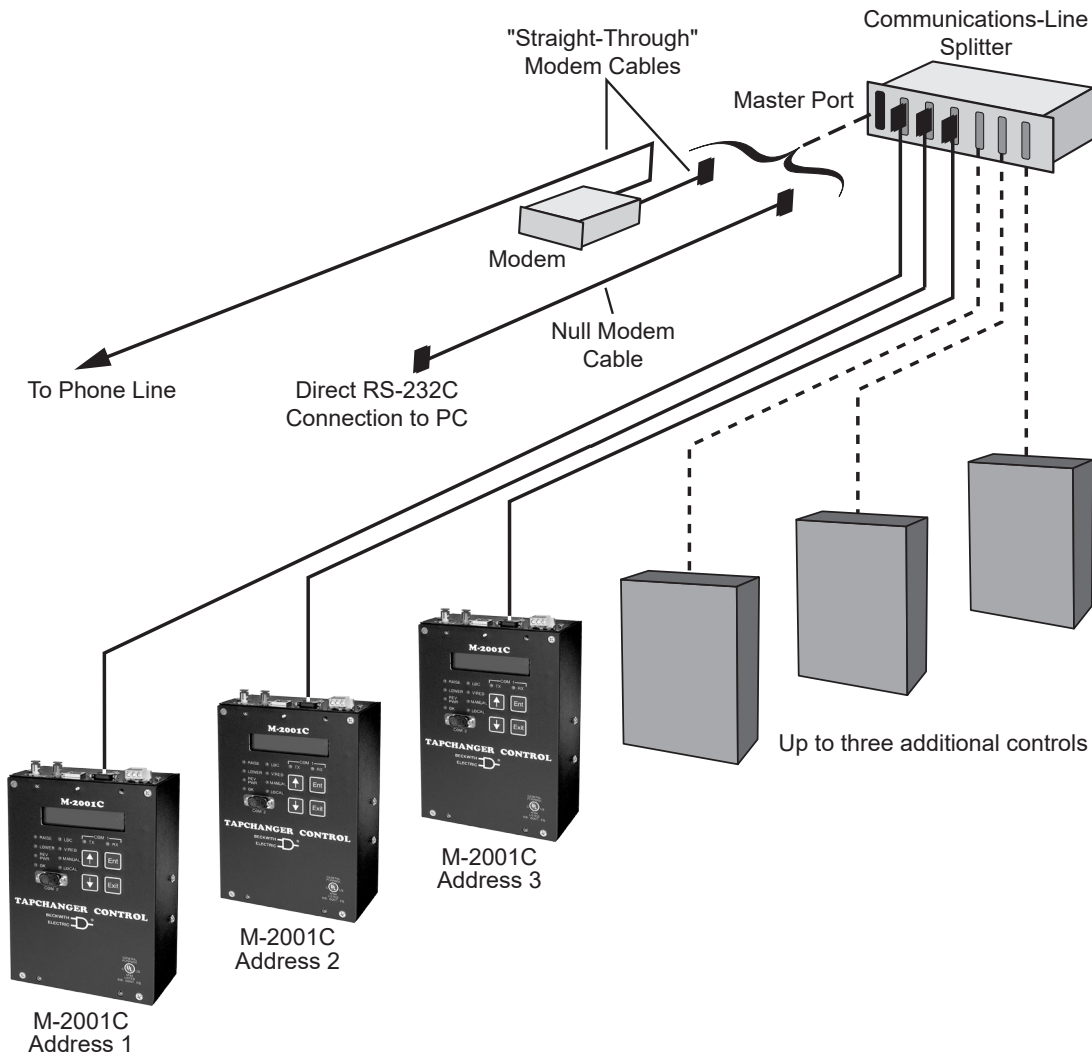


Figure 3 Network Connection (Comprehensive and Base-RS Models)

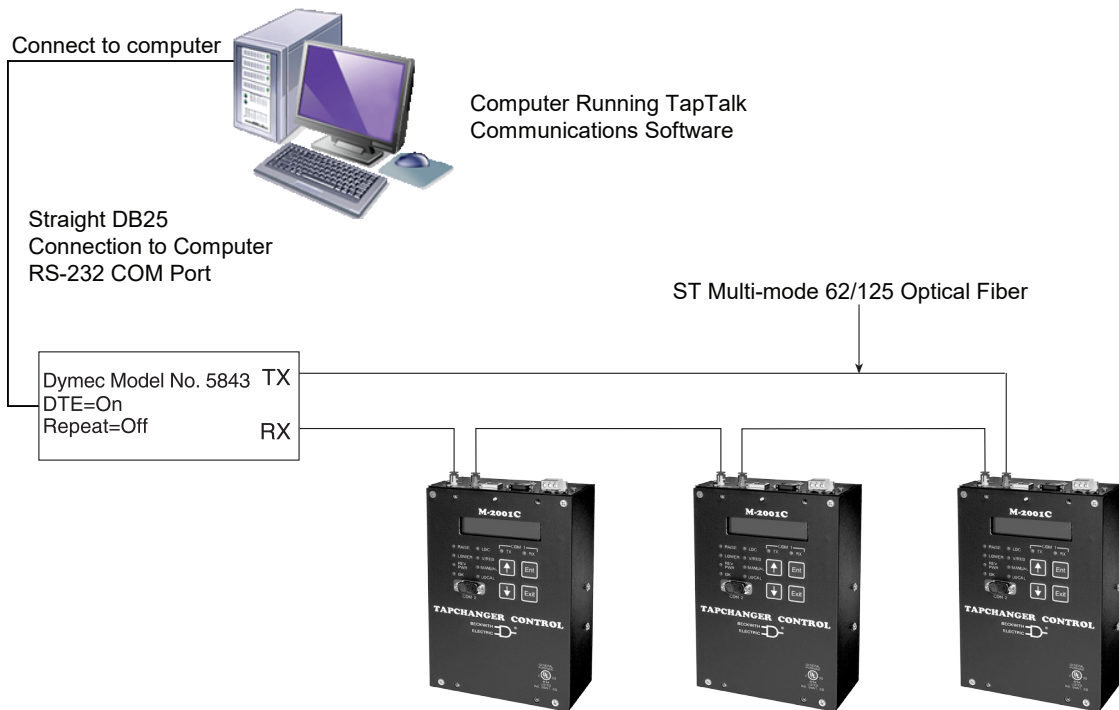


Figure 4 Fiber Optic Connection Loop (Comprehensive and Base-RS Models)

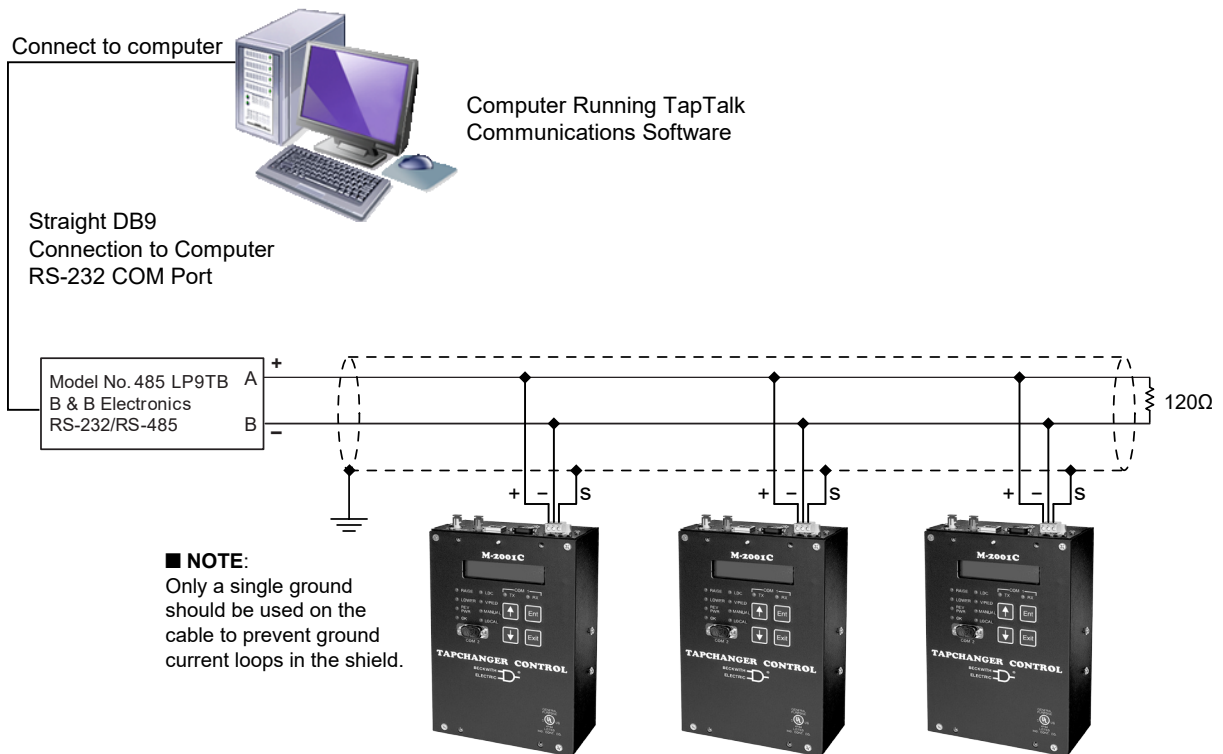


Figure 5 RS-485 Network Connection (Comprehensive and Base-RS Models)

## Tests and Standards

M-2001C Digital Tapchanger Control complies with the following type tests and standards:

### Voltage Withstand

#### *Dielectric Withstand*

IEC 60255-5            1,500 Vac for 1 minute applied to each independent circuit to earth  
                                 1,500 Vac for 1 minute applied between each independent circuit

#### *Impulse Voltage*

IEC 60255-5            5,000 V pk, +/- polarity applied to each independent circuit to earth  
                                 5,000 V pk, +/- polarity applied between each independent circuit  
                                 1.2 by 50  $\mu$ s, 500 ohms impedance, three surges at 1 every 5 seconds

IEC 60255-5            > 100 Megaohms

### Electrical Environment

#### *Electrostatic Discharge Test*

IEC 60255-22-2        Class 4 (8 kV) – point contact discharge

IEC 60255-22-2        Class 4 (15 kV) – air discharge

#### *Fast Transient Disturbance Test*

IEC 60255-22-4        Class A (4 kV, 2.5 kHz)

#### *Surge Withstand Capability*

ANSI/IEEE            2,500 V pk-pk oscillatory applied to each independent circuit to earth  
C37.90.1-            2,500 V pk-pk oscillatory applied between each independent circuit  
1989                    5,000 V pk Fast Transient applied to each independent circuit to earth  
                                 5,000 V pk Fast Transient applied between each independent circuit

ANSI/IEEE            2,500 V pk-pk oscillatory applied to each independent circuit to earth  
C37.90.1-            2,500 V pk-pk oscillatory applied between each independent circuit  
2002                    4,000 V pk Fast Transient burst applied to each independent circuit to earth  
                                 4,000 V pk Fast Transient burst applied between each independent circuit

■ **NOTE:** The signal is applied to the digital data circuits (RS-232, RS-485, Ethernet communication port coupling port) through capacitive coupling clamp.

#### *Surge Immunity*

IEC 60255-22-5        2,000 V pk,  $\pm$  polarity applied, 1.2  $\mu$ s by 50  $\mu$ s, five surges, 1 every 5 seconds

#### *Radiated Electromagnetic Withstand Capability*

All units protected against electromagnetic radiated interference from portable communications transceivers

## Atmospheric Environment

**Temperature:** Control operates from -40° C to +85° C with either the LCD or Vacuum Fluorescent Display

■ **NOTE:** The LCD display's functional temperature range is -20° C to +70° C. The optional vacuum fluorescent display's functional temperature range is -40° C to +80° C.

IEC 60068-2-1	Cold, -40° C
IEC 60068-2-2	Dry Heat, +80° C
IEC 60068-2-78	Damp Heat, +40° C @ 93% <sub>RH</sub>
IEC 60068-2-30	Damp Heat Condensation Cycle, 25° C, +40° C @ 95% <sub>RH</sub>

## Mechanical Environment

### Vibration

IEC 60255-21-1	Vibration response Class 1, 0.5 g Vibration endurance Class 1, 1.0 g
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## Compliance

cULus-Listed per 508 – Industrial Control Equipment  
 – Industrial Control Equipment Certified for Canada CAN/CSA C22.2 No. 14-M91  
 cULus-Listed Component per 508A Table SA1.1 Industrial Control Panels

## Recommended Storage Parameters

**Temperature:** 5° C to 40° C

**Humidity:** Maximum relative humidity 80% for temperatures up to 31° C, decreasing to 31° C linearly to 50% relative humidity at 40° C.

**Environment:** Storage area to be free of dust, corrosive gases, flammable materials, dew, percolating water, rain and solar radiation.

**Periodic Surveillance During Storage:** The M-2001C contains electrolytic capacitors. It is recommended that power be applied to the control every three to five years for a period not less than one hour to help prevent the electrolytic capacitors from drying out.

## Physical (All Models)

**Size:** 5 13/16" wide x 8 1/2" high x 3" deep (10.81 cm x 21.6 cm x 7.62 cm)

**Mounting:** Unit mounts directly to adapter or conversion front panels sized to replace popular industry tapchanger controls.

**Approximate Weight:** 3 lbs, 11 oz (1.67 kg)

**Approximate Shipping Weight:** 6 lbs, 11 oz (3.03 kg)

## Optional Accessories

### M-2025B (D) Current Loop Interface Modules and M-2948 Tap Position Sensor

The M-2025B(D) Current Loop Interface Modules are a current-to-voltage analog converters that can accept inputs from M-2948 Beckwith Electric Tap Position Sensors ([Table 1](#)) or Incon 1250B Rotary Position Sensor.

Sensor	Rotation	Degrees/ Tap	Taps	Neutrals
M-2948-91N	Negative	9°	±16	1
M-2948-91P	Positive	9°	±16	1
M-2948-92N	Negative	9°	±16	2
M-2948-92P	Positive	9°	±16	2
M-2948-93N	Negative	9°	±16	3
M-2948-93P	Positive	9°	±16	3
M-2948-95N	Negative	9°	±16	5
M-2948-95P	Positive	9°	±16	5
M-2948-11N	Negative	10°	±16	1
M-2948-11P	Positive	10°	±16	1
M-2948-12N	Negative	10°	±16	2
M-2948-12P	Positive	10°	±16	2
M-2948-13N	Negative	10°	±16	3
M-2948-13P	Positive	10°	±16	3
M-2948-16N	Negative	10°	±8	6
M-2948-16P	Positive	10°	±8	6

■ **NOTE:** Tap Position Sensors are available with either a positive "P" or negative "N" rotation. With **positive** rotation, the shaft of the M-2948 rotates **clockwise** while raising taps. With **negative** rotation, the shaft of the M-2948 rotates **counter-clockwise** while raising taps.

*Table 1 M-2948 Model Application Information*

The tap position sensors are rotary shaft encoders with built-in microprocessors that provide stepped output signals in 9 or 10 degree increments. [Table 1](#) illustrates the available rotation, tap and neutral configurations. The electrical output of these sensors is a 4-20 mA current loop that converts easily to a voltage signal at the input of the M-2025B(D) with the addition of a proper value shunt resistor. For a 4-20 MA Current Loop, 150 ohms is required on the input of the M-2025B(D).



### **Configurations**

Most LTC tapchangers have an output shaft on the tapchanger mechanism whose angular position is a mechanical analog of the tapchanger tap position. In many cases, the total range of tap positions is represented by less than one complete rotation of this position output shaft. The typical values of shaft movement on 32 tap mechanisms are 9° or 10° of mechanical rotation per tap position.

Other angular rotation values are likely to be encountered. Contact Beckwith Electric for information on sensor availability for specific requirements.

### **Application Notes**

- The M-2948 Tap Position Sensor directly mounts in place of the Incon Tap Sensor Model 1292.
- The M-2948 Tap Position Sensor directly mechanically replaces the Selsyn-Type Position Sensor.
- The M-2948-91N Tap Position Sensor is for use with a Qualitrol Position Indicator, Model 081-002-01 or equivalent.

### **Incon Tap Position Monitor connected to an Incon 1250 Series Rotary Position Sensor**

Both types of devices provide a 4-20 mA dc current loop output. The current loop develops a voltage across a properly sized resistor on the input to the M-2025B(D). The resultant voltage signal is conditioned in the M-2025B(D) and routed to the M-2001 series Tapchanger Control where the voltage is converted to a corresponding tap position number.

The tap position sensors are rotary shaft encoders with built-in microprocessors that provide stepped output signals in 9 or 10 degree increments. They have rotations of 288 and 320 degrees respectively for 32 taps and one neutral position. The electrical output of these sensors is a 4-20 mA current loop that converts easily to a voltage signal at the input of the M-2025B(D) with the addition of a proper value shunt resistor. For a 4-20 MA Current Loop, 150 ohms is required on the input of the M-2025B(D).

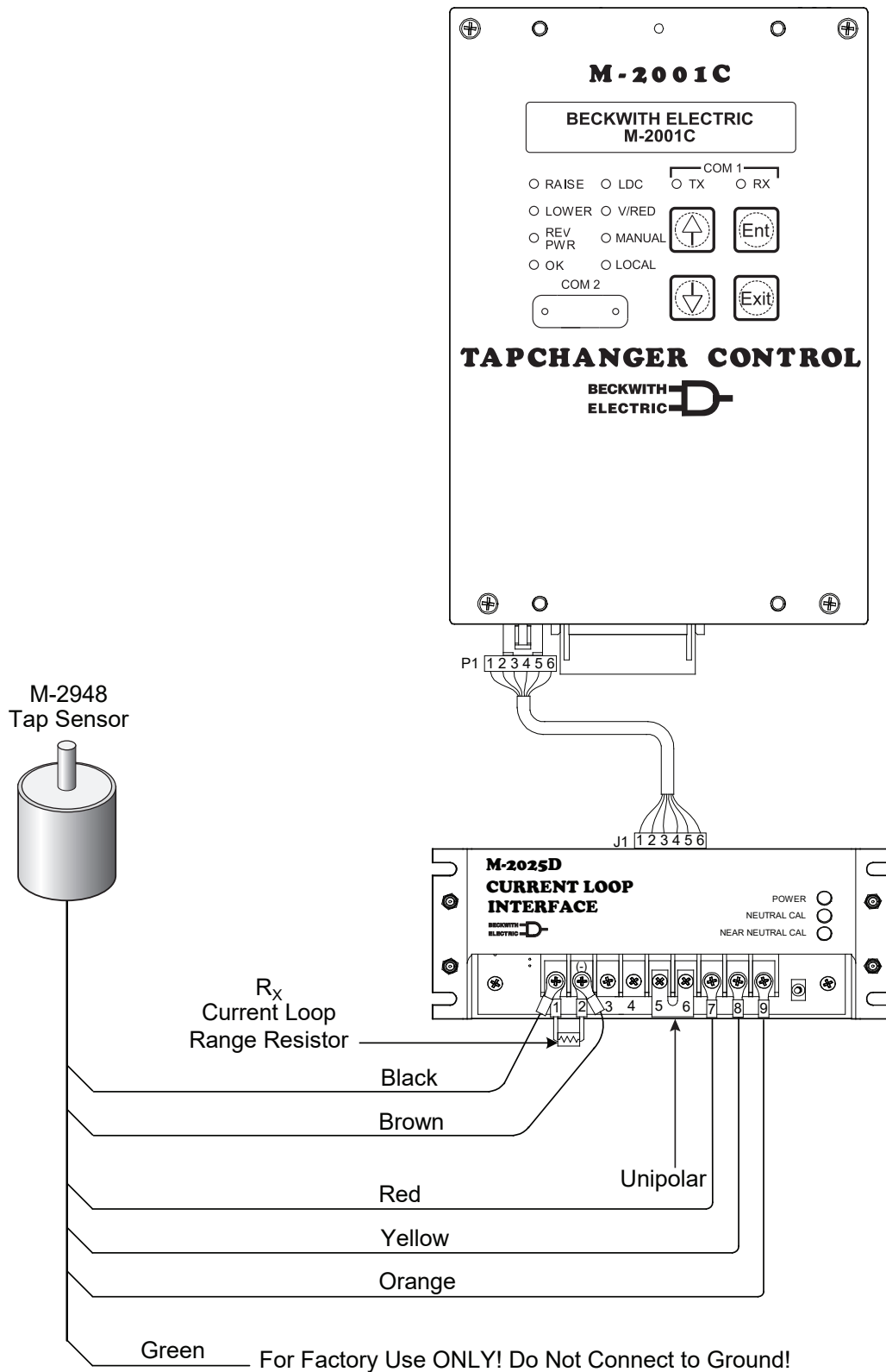


Figure 6 Typical M-2025D External Tap Position Interface with M-2948 Tap Position Sensor

### M-2026/M-2027 Control Power Backup Supplies

If the optional Control Power Backup Input is purchased, the following accessories are available:

#### M-2026 AC-DC Control Power Backup Supply

The M-2026 will output a regulated +12 Vdc ( $\pm 0.5$  V) output voltage. The unit incorporates a fused input, surge protection, and reverse polarity protection. The M-2026 is capable of up to a 1.5 Ampere output. The M-2026 Control Power Backup Supply will accept an AC and/or DC input over the following ranges:

- 21 to 32 Vdc
- 42 to 60 Vdc
- 105 to 145 V AC/DC

#### M-2027 Control Power Backup Supply-AC Only

The M-2027 will accept an AC (105 to 140 Vac, 50/60 Hz) input and output +12 Vdc (Nominal). The M-2027 is capable of loads up to 1.0 Ampere. The unit incorporates a fused input and surge protection.

The M-2026 and M-2027 units are housed in a non-weathertight enclosure and equipped with screw terminal blocks for input and output connections.

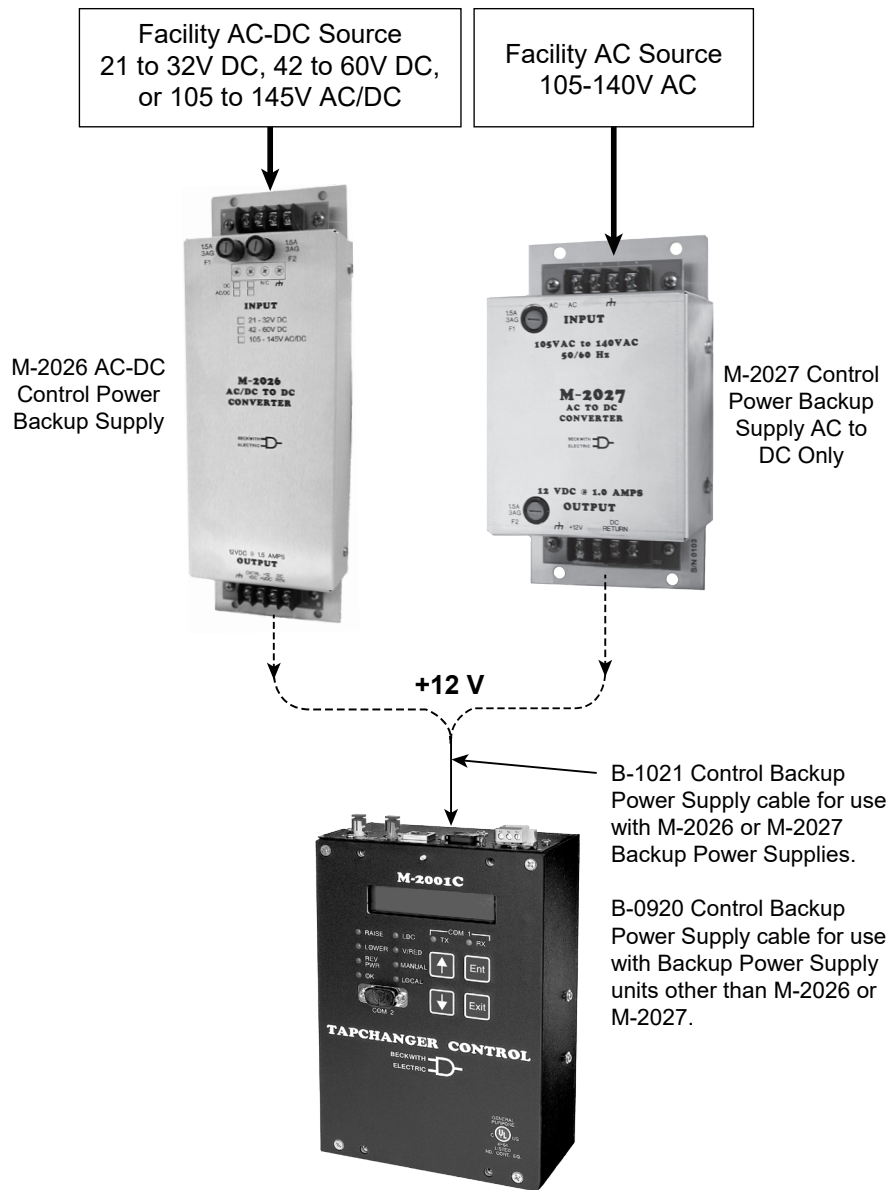


Figure 7 Typical M-2026/M-2027 Control Power Backup Supply Application

## M-2001C Style Selection Chart

**M-2001C 6 N L A A**

<p><b>Frequency</b></p> <p><b>6</b> = 60 Hz operation  <b>5</b> = 50 Hz operation</p> <p><b>Control Type</b></p> <p><b>N</b> = Base-R  <b>R</b> = Base-RS w/RS-485  <b>F</b> = Base-RS w/Fiber  <b>T</b> = Base-T  <b>S</b> = Comprehensive  <b>E</b> = Comp. w/Ethernet</p> <p><b>Display Type</b></p> <p><b>L</b> = LCD  <b>V</b> = Vacuum Fluorescent</p> <p><b>Additional Options</b></p> <p><b>A</b> = No additional Option  <b>B</b> = ΔVAR Paralleling  <b>C</b> = Backup DC power input  <b>D</b> = Both B &amp; C  <b>F</b> = French  <b>G</b> = French &amp; ΔVAr</p> <p><b>Customer MODs</b></p> <p><b>A</b> = No MOD  <b>B</b> = MOD 266  <b>C</b> = MOD 330  <b>D</b> = MOD 362  <b>E</b> = MOD 465  <b>F</b> = MOD 467  <b>G</b> = MOD 467R  <b>H</b> = MOD 608  <b>I</b> = MOD 609  <b>K</b> = MOD 615  <b>L</b> = MOD 608 &amp; 615</p>	
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Option Availability:	VFD	ΔVAR	Ethernet	DC pwr
<b>M-2001C - Comp</b>	Yes	Yes	Yes	Yes
<b>M-2001C - Base-T</b>	Yes	Yes	N/A	N/A
<b>M-2001C - Base-R</b>	Yes	N/A	N/A	N/A
<b>M-2001C - Base-RS</b>	Yes	N/A	N/A	Yes

**Example Style Numbers:**

**M-2001C-6SV Comprehensive** LTC Control (60Hz) with Vacuum Fluorescent Display (VFD). Inputs/Outputs: Non-sequential, Paralleling, Alarms, Tap Info (INCON), Voltage Reduction, LDC. Communication: RS232, RS485 & Fiber optic ports, 10 protocols including DNP3.0 & MODBUS.

**M-2001C-5TLBA Base-T** LTC Control (50Hz) With LCD. Inputs/Outputs: Non-sequential, Paralleling, Alarms, Tap Info (INCON), Voltage Reduction, LDC. Communication: RS232, BECO-2200 protocol only. Options: ΔVAR paralleling.

**M-2001C-6NL Base-R** Regulator Control (60Hz) With LCD. Inputs: Voltage Reduction, LDC. Communication: RS232, BECO-2200 protocol only.

### **Patent & Warranty**

The M-2001C Tapchanger Control is covered by U.S. Patents 5,315,527 and 5,581,173.

The M-2001C Tapchanger Control, M-2026 AC-DC Control Power Backup Supply and M-2027 Control Power Backup Supply-AC Only, M-2948 Tap Position Sensor, and M-2025B(D) Current Loop Interface Modules are covered by a five-year warranty from date of shipment.

### **Trademarks**

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*Specification subject to change without notice. Beckwith Electric has approved only the English version of this document.*



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