Digital Tapchanger Control M-2001C

Digital Tapchanger Control for Transformers and Regulators

- 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, including IEC-61850
- 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 Controlable Auto/Manual Pushbutton) Adapter Panel Auto/Manual Switch State can be changed by a SCADA command pushbutton
- Overcurrent protection
- LDC with R & X or Z-compensation
- Increased Bandwidth to 10 Volts
- Ethernet port optional

Comprehensive Model Shown

- 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.) Vacuum Fluorescent display optionally available (rated –40 to +80 degrees Celsius.)
- Optional Control Power Backup Input for Fiber Optic loop-through communication
- M-2829 TapPlot™ for Windows™ Analysis Software allows the plotting, printing and analysis of Tap Information

Comprehensive Version Features

The Comprehensive version includes all M-2001C features and can be used for LTCs or regulators where SCADA communications are desired.

- Adjustable Bandcenter
- Adjustable Bandwidth
- Line Drop Compensation, R and X Compensation
- Time Delay, Definite and Inverse
- InterTap Time Delay
- Selectable Outputs, Continuous or Pulsed
- Reverse Power Operation, for Single-Phase Regulator applications
- CT to VT Phasing Correction
- Real-Time Metering of measured and calculated parameters
- Demand Metering with selectable time interval
- Drag Hands Operation
- Adjustable Line Overcurrent Tapchange Inhibit
- Voltage Limits
- Tap Position Limits
- Runback
- Three independent Voltage Reduction Steps
- Sequential and Non-Sequential Operation
- VT Ratio Correction
- Self-Test Alarm Output Contacts
- User Programmable Alarm Contacts
- Tap Position Knowledge by "Keep Track" method
- Operations Counter
- Resettable Operations Counter
- Harmonic Analysis through TapTalk®
- Tap Position Record
- Auto/Off/Manual Switch Status
- A or B Regulator Type Selection
- Alarm Contact Outputs (2)
- Control Voltage Input
- Motor Power Input
- Line Current Input
- Raise Output
- Lower Output
- 20 Character by 2 Row LCD Display
- M-2029A TapTalk Communications Software
- M-2829 TapPlot™ Tap Analysis Software
- Adapter Panel Auto/Manual Switch Type Selection
- Front RS-232 Communications Port COM2
- External Inhibit of Auto Tapchange
- Circulating Current Paralleling Method
- Tap Position Knowledge by Current Loop Method
- Front Panel LEDs for 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, Auto Operation Block **MANUAL**, SCADA Control blocked **LOCAL** and Com1 **TX** and **RX**.
- Circulating Current Input
- Voltage Reduction 1 & 2 Inputs (Binary) (3 Steps Total)
- Neutral Position Detect (Binary)
- Counter Input (Binary)
- Seal-in/Switch Status Input (Binary)
- Non-Sequentail/SCADA Block Input (Binary)
- Seal-in Output
- COM1 (top) RS-232, RS-485 and Fiber Optics
- Communication Protocols include BECO 2200, BECO 2179, Cooper 2179, Cooper 2179A, GP-2179, GP DNP3.0, DNP3.0, AL PWR DNP 3.0, MODBUS, UCA 2.0, and IEC-61850 (when used with the optional ethernet port)

Comprehensive Optional Features

- Paralleling ΔVAR™ Methods
- Vacuum Fluorescent Display(rated –40 to +80 degrees Celsius.)
- Ethernet Port COM3 (10 Mpbs) is available through an RJ-45 jack on the top of the control. This port supports DNP over TCP/IP, BECO 2200 over TCP/IP, MODBUS over TCP/IP, and IEC-61850 over TCP/IP
- Control Power Back-Up Input – input (+12 V dc) for backup of Fiber Optic loop-through communication

Comprehensive Accessories

- M-2025C Current Loop Interface Module-Current-To-Voltage analog converter for tap position sensors
- M-2026 AC-DC Control Power Backup Supply
- M-2027 Control Power Backup Supply–AC Only
- M-2948 Tap Position Sensor - measures a 0^0 to 288^0 rotation
- M-2949 Tap Position Sensor - measures a 0^0 to 320^0 rotation

Base-T Version Features

The Base-T version of the M-2001C is designed for transformers. It uses one COMM port (Com2) for communications.

- Adjustable Bandcenter
- Adjustable Bandwidth
- Line Drop Compensation, R and X Compensation
- Time Delay, Definite and Inverse
- InterTap Time Delay
- Selectable Outputs, Continuous or Pulsed
- Reverse Power Operation, for Single-Phase Regulator applications
- CT to VT Phasing Correction
- Real-Time Metering of measured and calculated parameters
- Demand Metering with selectable time interval
- Drag Hands Operation
- Adjustable Line Overcurrent Tapchange Inhibit
- Voltage Limits
- Tap Position Limits
- Runback
- Three independent Voltage Reduction Steps
- Sequential and Non-Sequential Operation
- VT Ratio Correction
- Self-Test Alarm Output Contacts
- User Programmable Alarm Contacts
- Tap Position Knowledge by "Keep Track" method
- Operations Counter
- Resettable Operations Counter
- Harmonic Analysis
- Tap Position Record
- Auto/Off/Manual Switch Status
- A or B Regulator Type Selection
- Alarm Contact Outputs (2)
- Control Voltage Input
- Motor Power Input
- Line Current Input
- Raise Output
- Lower Output
- 20 Character by 2 Row LCD Display
- M-2029A TapTalk® Communications Software
- M-2829 TapPlot™ Tap Analysis Software
- Front Panel LEDs for 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 and Auto Operation block **MANUAL** (**LOCAL** LED is NOT functional on BASE-T Versions).
- Includes BECO 2200 protocol on COM2 port
- Circulating Current Paralleling Method
- Front RS-232 Communications Port COM2
- Tap Position Knowledge by Current Loop Method
- External inhibit of Auto Tapchange (non-sequential)
- Circulating Current Input
- Voltage Reduction 1 & 2 Inputs (Binary) (3 Steps Total)
- Neutral Position Detect (Binary)
- Counter Input (Binary)
- Seal-in/Switch Status Input (Binary)
- Non-sequential/SCADA Block Input (Binary)
- Seal-in Output

Base-T Optional Features

- Vacuum Fluorescent Display(rated -40 to +80 degrees Celsius.)
- **ΔVAR™** Paralleling Methods

Base-T Accessories

- M-2025C Current Loop Interface Module-Current-To-Voltage analog converter for tap position sensors
- M-2026 AC-DC Control Power Backup Supply
- M-2027 Control Power Backup Supply - AC Only
- M-2948 Tap Position Sensor - measures a 0^0 to 288^0 rotation
- M-2949 Tap Position Sensor - measures a 0^0 to 320^0 rotation

Base-RS Version Features

The Base-RS version of the M-2001C is designed primarily for regulators, but can also be applied to LTCs where SCADA communication is required. It provides one SCADA COMM port (COM1) as either an optional RS-485 or fiber optics port for communications.

- Adjustable Bandcenter
- Adjustable Bandwidth
- Line Drop Compensation, R and X Compensation
- Time Delay, Definite and Inverse
- InterTap Time Delay
- Selectable Outputs, Continuous or Pulsed
- Reverse Power Operation, for Single-Phase Regulator applications
- CT to VT Phasing Correction
- Real-Time Metering of measured and calculated parameters
- Demand Metering with selectable time interval
- Drag Hands Operation
- Adjustable Line Overcurrent Tapchange Inhibit
- Voltage Limits
- Tap Position Limits
- Runback
- Three independent Voltage Reduction Steps
- Sequential and Non-Sequential Operation
- VT Ratio Correction
- Tap Position Knowledge by "Keep Track" method
- Operations Counter
- Resettable Operations Counter
- Harmonic Analysis through TapTalk®
- Tap Position Record
- Auto/Off/Manual Switch Status
- A or B Regulator Type Selection
- Control Voltage Input
- Motor Power Input
- Line Current Input
- Raise Output
- Lower Output
- 20 Character by 2 Row LCD Display
- M-2029A TapTalk Communications Software
- M-2829 TapPlot™ Tap Analysis Software
- Adapter Panel Auto/Manual Switch Type Selection
- Front Panel LEDs for 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, Auto Operation Block **MANUAL**, SCADA Control blocked **LOCAL** and Com1 **TX** and **RX**.
- Includes BECO 2200 protocol on COM2 port
- Front RS-232 Communications Port COM2
- Voltage Reduction 1 & 2 Inputs (Binary) (3 Steps Total)
- Non-Sequential/SCADA Block Input (Binary)
- Neutral Position Detect (Binary)
- Counter Input (Binary)
- Seal-in/Switch Status Input (Binary)
- Seal-in Output
- Communication Protocols include BECO 2200, BECO 2179, Cooper 2179, Cooper 2179A, GP-2179, GP DNP3.0, DNP3.0, AL PWR DNP 3.0, MODBUS and IEC-61850.

Base-RS Optional Features

- Vacuum Fluorescent Display (rated -40 to +80 degrees Celsius.)
- COM1 (top) RS-485 or Fiber Optics

Base-R Version Features

The Base-R version of the M-2001C 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.

- Adjustable Bandcenter
- Adjustable Bandwidth
- Line Drop Compensation, R and X Compensation
- Time Delay, Definite and Inverse
- InterTap Time Delay
- Selectable Outputs, Continuous or Pulsed
- Reverse Power Operation, for Transformer LTC and Single-Phase Regulator applications
- CT to VT Phasing Correction
- Real-Time Metering of measured and calculated parameters
- Demand Metering with selectable time interval
- Drag Hands Operation
- Adjustable Line Overcurrent Tapchange Inhibit
- Voltage Limits
- Tap Position Limits
- Runback
- Three independent Voltage Reduction Steps
- Sequential Operation
- VT Ratio Correction
- Tap Position Knowledge by "Keep Track" method
- Operations Counter
- Resettable Operations Counter
- Harmonic Analysis
- Tap Position Record
- Auto/Off/Manual Switch Status
- A or B Regulator Type Selection
- Control Voltage Input
- Motor Power Input
- Line Current Input
- Raise Output
- Lower Output
- 20 Character by 2 Row LCD Display
- M-2029A TapTalk® Communications Software
- M-2829 TapPlot™ Tap Analysis Software
- Front Panel LEDs for 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 and Auto Operation block **MANUAL** (**LOCAL** LED is NOT functional on BASE-R Versions).
- Includes BECO 2200 protocol on COM2 port
- Front RS-232 Communications Port COM2
- Voltage Reduction 1 & 2 Inputs (Binary) (3 Steps Total)
- Neutral Position Detect (Binary)
- Counter Input (Binary)
- Seal-in/Switch Status Input (Binary)
- Seal-in Output

Base-R Optional Features

- Vacuum Fluorescent Display (rated -40 to +80 degrees Celsius.)

Features

■ **NOTE**: Not all features are included in all versions.

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 ignore, block, regulate rev, or return to neutral operation with reverse power (when using positive tap position knowledge).

Single-Phase Regulators: If "keep track" tap position indication is applicable, unit may be set to "Return to Neutral" or "Regulate Reverse". The Regulate Reverse feature allows separate setpoints and regulation in the reverse direction without the installation of source-side VTs, otherwise it can be set to Ignore or Block.

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 kVAr, or MVAr
- 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 kVAr, or MVAr
- 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.

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.

ΔVAR™: When specified, the ΔVAR1 method may be implemented by using separate balancing equipment such as the M-0115A Balancing Module. The ΔVAR2 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 ΔVAR2, 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 Current Loop Interface Module receives a signal from a position transducer 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 an internal "keep track" 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.

Inputs

Control Voltage Input: Nominal 120 V ac, 60 Hz (50 Hz optional); operates properly from 90 V ac to 140 V ac. 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 V ac to 240 V ac, 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 400 mA for two hours 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 400 mA for two hours and 4 A for 1 second.

Control Power Backup Input (Six pin Molex connector on the left side bottom of control): The optional Control Power Backup Input feature 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. When this feature is enabled the Tap Position Knowledge by Current Loop feature is unavailable. See M-2026/M2027 Companion Control Power Backup Supplies (page 14).

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 "keep track" 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 Swtich 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 V ac motor power.

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

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

Deadman Alarm Output: Capable of switching 6 A at 120 V ac or 100 mA at 120 V dc.

Programmable Alarm Output: Capable of switching 3 A at 120 V ac or 100 mA at 120 V dc.

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 3A at 120 V ac and one normally closed self-test alarm contact; capable of switching 6 A at 120 V ac.

Voltage Measurement Accuracy

Control accuracy is ±0.3 % when tested in accordance with the ANSI/IEEE C57.15.9-1999 standard over a temperature range of –30° C to +65° C. The control accuracy is ±0.5% when tested over the full operational temperature range of –40° C to + 85° 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 IBM PC-compatible personal computer running the M-2029A 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 DNP 3.0, AL PWR DNP 3.0, DNP3.0, MODBUS, and IEC 61850 (when used with the optional ethernet port). 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 Mpbs 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, MODBUS over TCP/IP protocols and IEC61850.

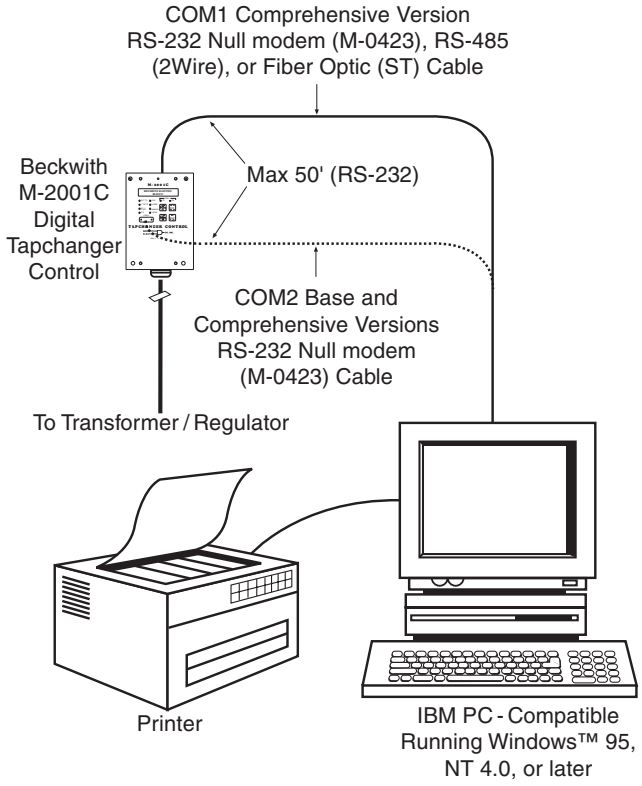


Figure 1 Direct Connection

Communications Via 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.

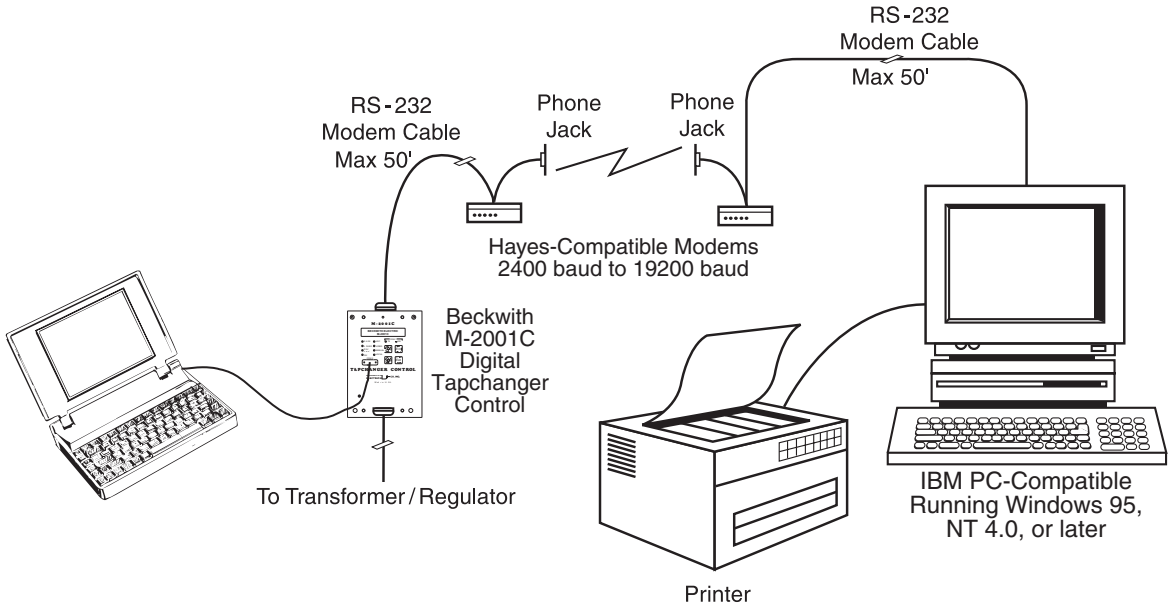


Figure 2 Modem Connection

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. Figures 3, 4, and 5 illustrate typical network configurations.

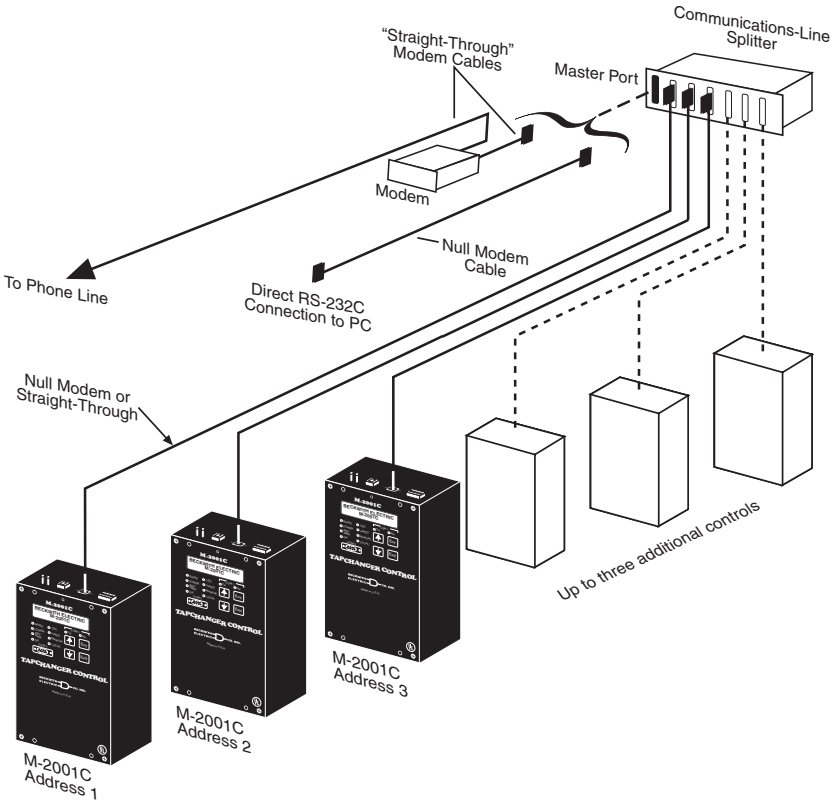


Figure 3 Network Connection

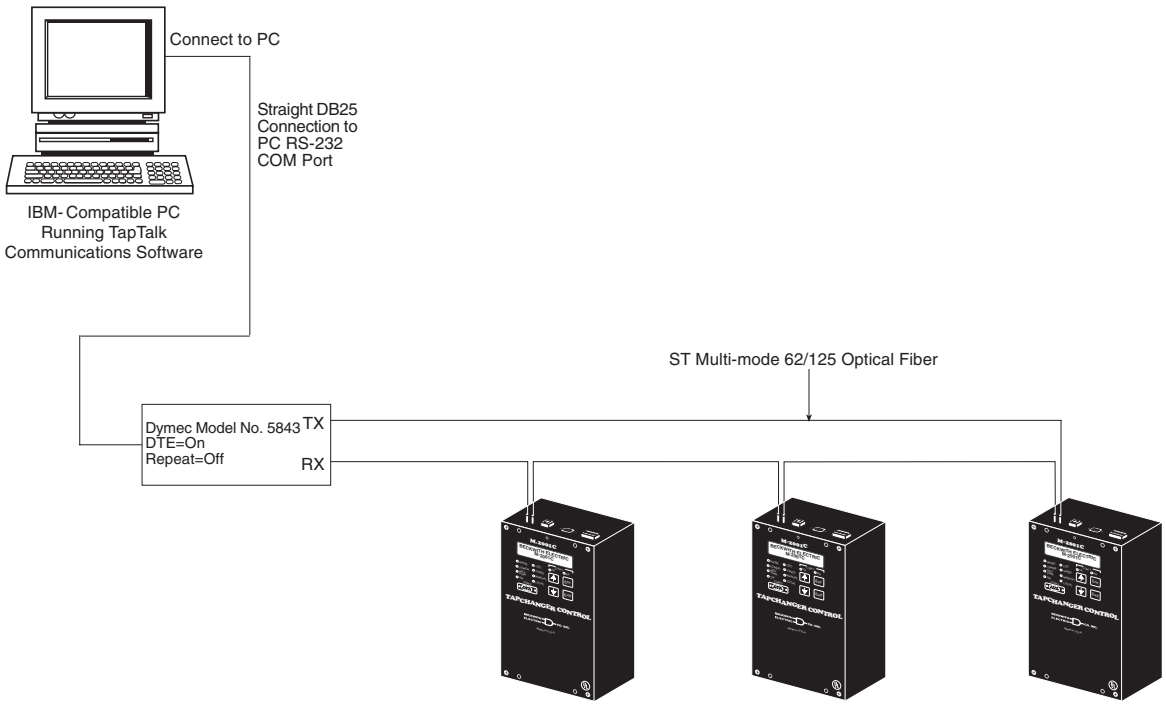


Figure 4 Fiber Optic Connection Loop

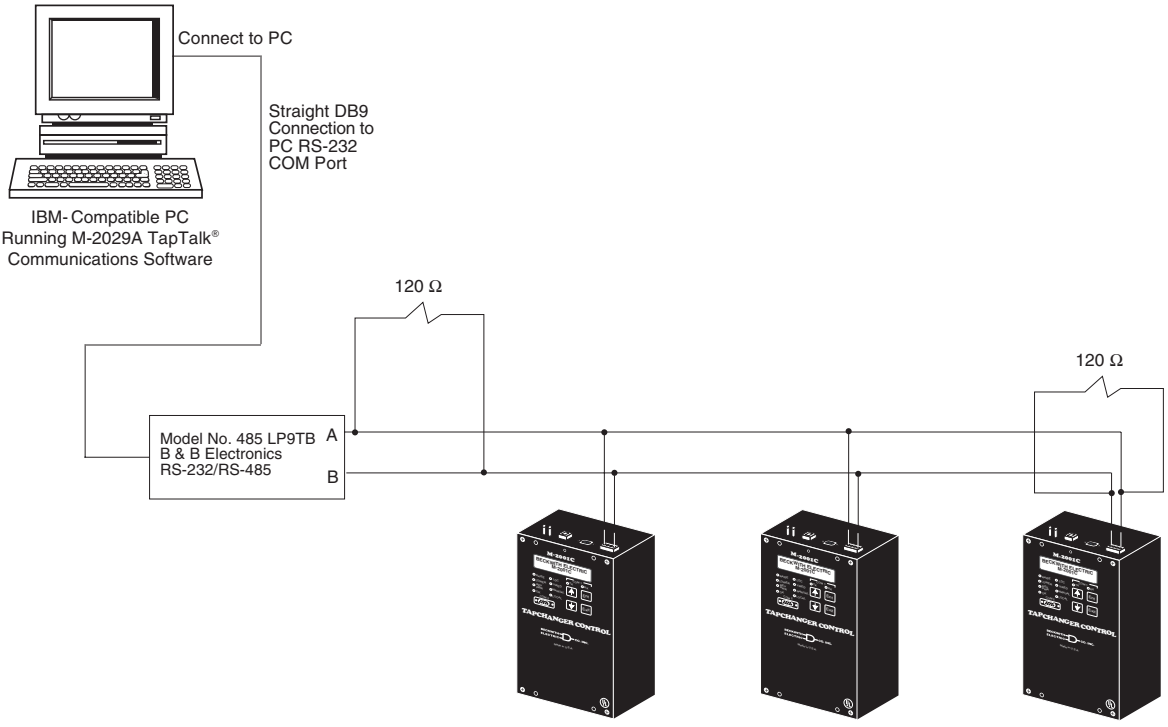


Figure 5 RS-485 Network Connection

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.

Environmental

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 for 96 hours
IEC 60068-2-2 Dry Heat, +80° C for 96 hours
IEC 60068-2-3 Damp Heat, +40° C @ 95% RH for 96 hours

Fungus Resistance: a conformal coating is available as an option on the printed circuit board to inhibit fungus growth.

Transient Protection

High Voltage

All input and output terminals will withstand 1500 V ac rms to chassis or instrument ground for one minute with a leakage current not to exceed 25 mA, for all terminals to ground. Input and output circuits are electrically isolated from each other, from other circuits and from ground.

■ **NOTE**: RS-232 and RS-485 communications ports are excluded.

Surge Withstand Capability

IEEE C37.90.1-2002	2,500 Vpk-pk Oscillatory 4,000 Vpk Fast Transient Burst
IEEE C37.90.1-1989	2,500 Vpk-pk Oscilliatory 5,000 Vpk Fast Transient

■ **NOTE**: Disturbance is applied to digital data circuits (RS-232, RS-485, RJ45 Ethernet) port through capactive coupling clamp.

Radiated Electromagnetic Withstand Capability

All units are protected against electromagnetic radiated interference from portable communications transceivers.

Electrostatic Discharge Test

EN 60255-22-2-1997 (EN61000-4-2)

Class 4	(8 Kv) – Point Contact Discharge (15 Kv) – Air Discharge

Fast Transient Disturbance Test

EN 60255-22-4-2002 (EN61000-4-4)

Class A (4 Kv, 2.5 kHz)

■ **NOTE**: Disturbance is applied to digital data circuits (RS-232, RS-485, RJ45 Ethernet) ports through capacitive coupling clamp.

Industrial Certifications

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

Physical

(M-2001C Comprehensive, BASE-T, BASE-RS, BASE-R)

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)

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 and M-2949 Tap Position Sensors, and M-2025B(C) Current Loop Interface Modules are covered by a five-year warranty from date of shipment.

Specification subject to change without notice.

M-2025B and M-2025C Current Loop Interface Modules, M-2948 and M-2949 Tap Position Sensors

The M-2025B(C) Current Loop Interface Modules are a current-to-voltage analog converters that can accept inputs from:

- Beckwith Electric Tap Position Sensors
  - Model M-2948 (9^0 per tap)
  - Model M-2949 (10^0 per tap)
  - Future models as required

- 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(C). The resultant voltage signal is conditioned in the M-2025B(C) 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 easliy to a voltage signal at the input of the M-2025B(C) 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(C).

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 9^0 or 10^0 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.

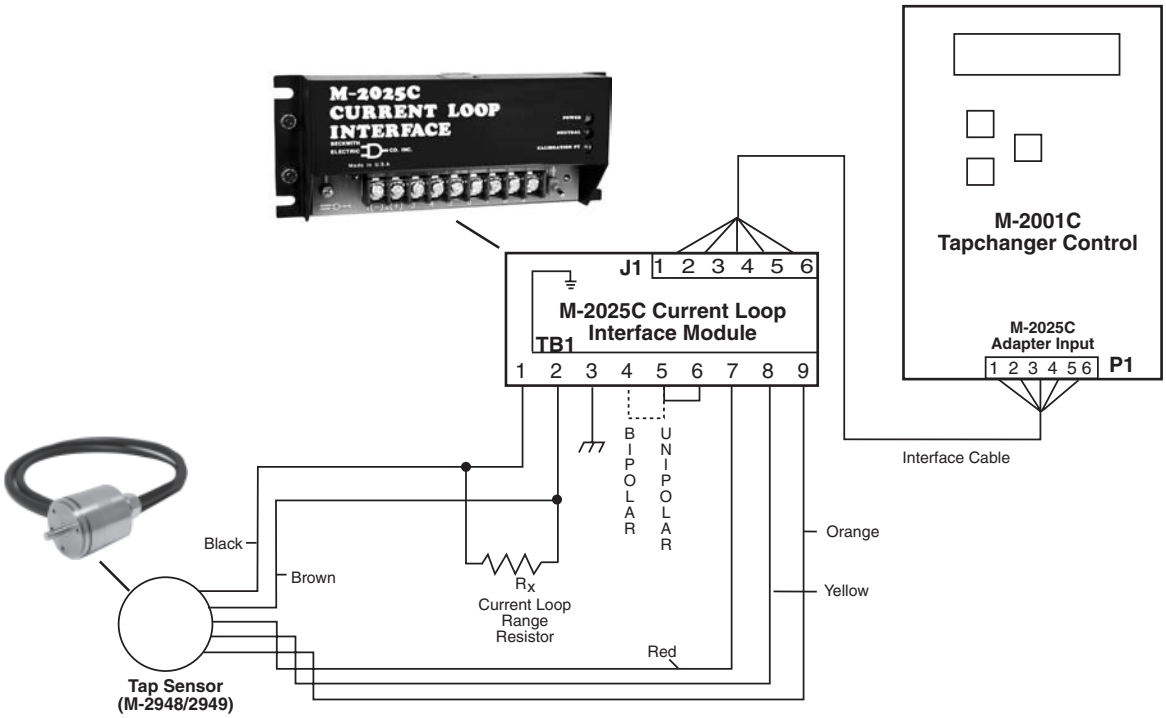


Figure 6 Typical M-2025B(C) External Tap Position Interface with M-2948/M-2949 Tap Position Sensors

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

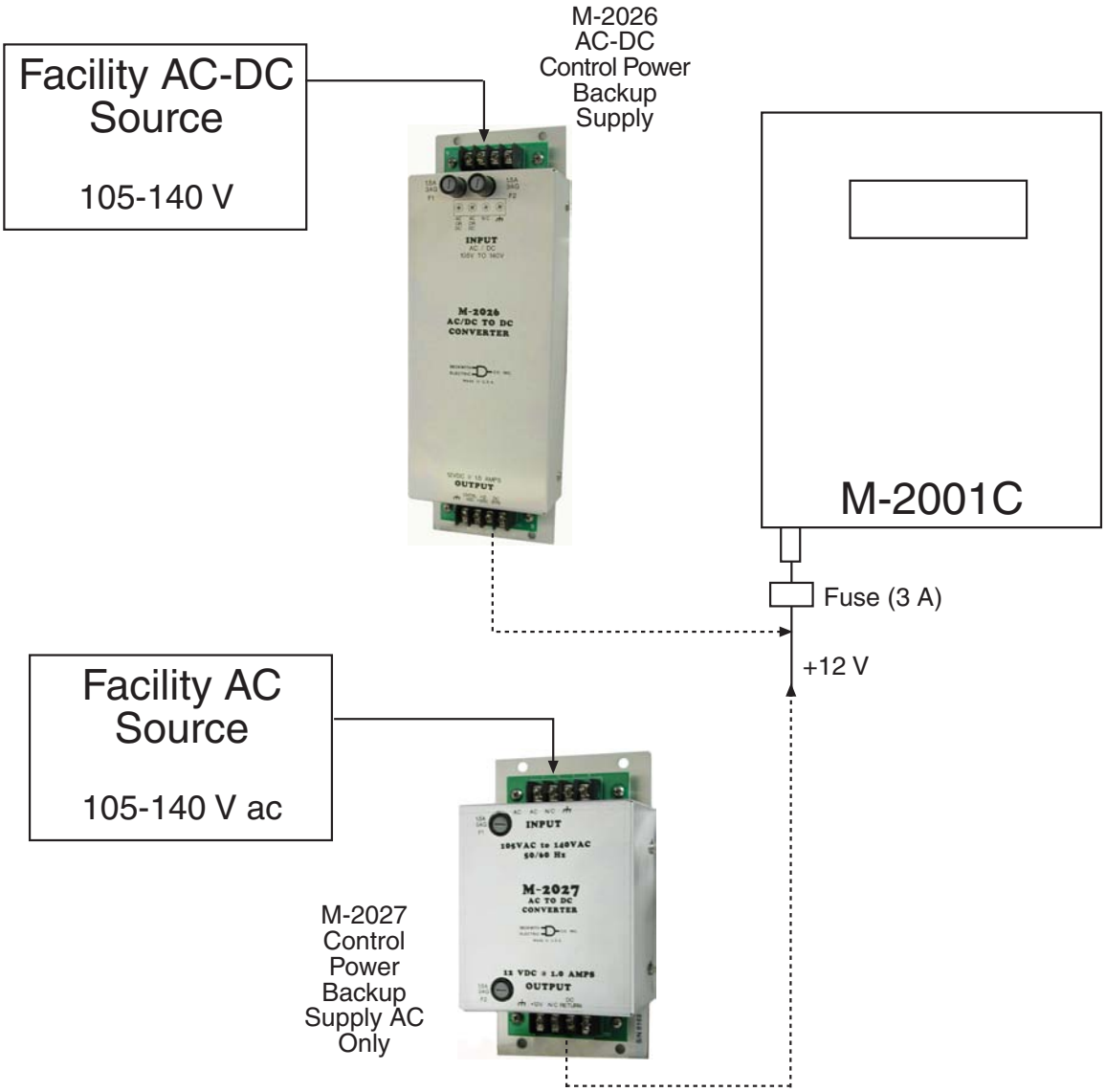
The M-2026 Control Power Backup Supply will accept either an AC or DC (105 to 140 V) input, and output a regulated +12 V dc (±0.5 V) output voltage. The unit incorporates a fused input, surge protection, and reverse polarity protection. The M-2026 is capable of up to a 1.5 Ampere output.

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 V dc (Nominal). The M-2027 is capable of loads up to 1.0 Ampere. The unit incorporates a fused input and surge protection.

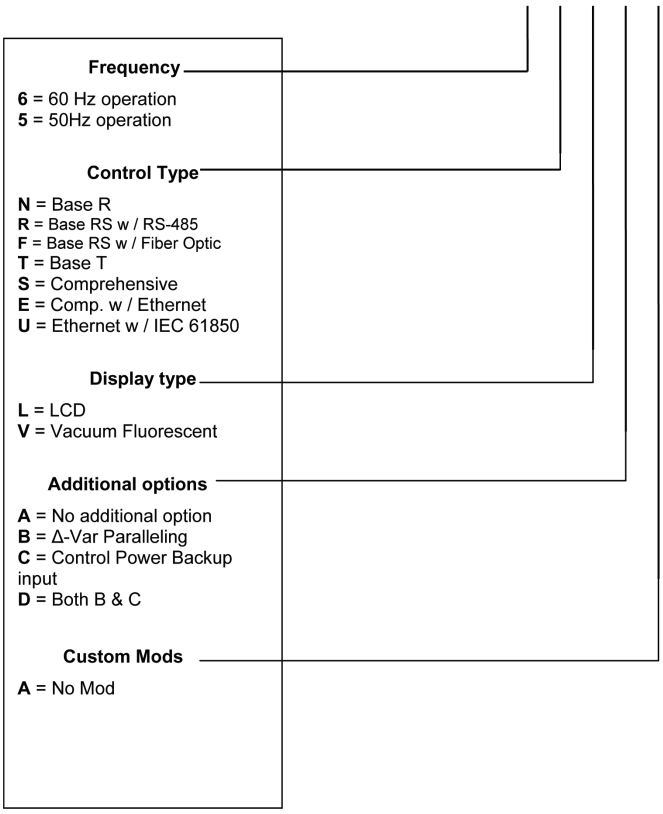
The M-2026 and M-2027 units are housed in a non-weathertight enclosure and equipped with screw terminal blocks for input and output connections.

■ **NOTE**: If the Optional Control Power Backup input is purchased, then Tap Information is limited to "keep track" only.



M-2001C Style Selection Chart

M-2001C- 6 N L A A



Option Availability:	VFD	D-VAR	Ethernet	DC pwr
M-2001C - Comp	Yes	Yes	Yes	Yes
M-2001C - Base-T	Yes	Yes	N/A	N/A
M-2001C - Base-R	Yes	N/A	N/A	N/A
M-2001C - Base-RS	Yes	N/A	N/A	N/A

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, 9 protocols including DNP 3.0 & 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: Delta Var paralleling

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

BECKWITH ELECTRIC CO., INC.
6190 - 118th Avenue North • Largo, Florida 33773-3724 U.S.A.
PHONE (727) 544-2326 • FAX (727) 546-0121
E-MAIL marketing@beckwithelectric.com
WEB PAGE www.beckwithelectric.com