TCC300
Digital Tapchanger Control for transformers and regulators

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The TCC300 is a dedicated controller for metering, monitoring, and operational control of step-voltage load tap changers. The TCC300 is a microprocessor-based package suitable for substation transformers with on-load tap changers. The TCC300 can be easily integrated to replace electromechanical on-load tap changer controllers or for new installations requiring state-of-the-art controllers. The TCC300 provides reliable operation with expanding capabilities such as means to address distributed generation and cyber security requirements.

Benefits

- Adapter panels to retrofit popular industry tapchanger controls
- USB 1.1 Communications Port for quick field-updatable programming
- Smart Reverse Power detection/operation with VT configuration for source and load sides
- Demand metering/Data Logging with Date/Time Stamp (Single/Three-Phase)
- Harmonic Analysis
- LDC with R & X or Z-compensation
- SCAMP (SCADA Controllable Auto/Manual Pushbutton) Adapter Panel Auto/Manual Switch State can be changed by a SCADA command
- Sequence of Events Recording
- SCADA HeartBeat
- Smart Flash SD Card
- Source PT Voltage Input
- CBEMA Monitoring
- VAr Bias for downstream coordination with capacitor controls
- Tap position knowledge by four KeepTrack™ methods
- Transformer paralleling by circulating current, Master/Follower (peer to peer) circuitry, or ΔVAR® methods
- LCD display (rated –20 to +70 degrees Celsius) or Vacuum Fluorescent display optionally available (rated -40 to +80 degrees Celsius)
- Optional Control Power Backup Input for Fiber Optic communication loop-through
- DNP3.0, MODBUS® and IEC 61850 Communications Protocols available
- Optional Ethernet RJ45 or Fiber Optic Ethernet

Features

The TCC300 includes the following features and can be used for LTCs or regulators where SCADA communications are desired.

- Adjustable Bandcenter
- Adjustable Bandwidth
- Adjustable VAr Bias (Step and Linear Methods)
- Line Drop Compensation, R, X and Z Compensation with ±72 Volt range
- Time Delay, Definite and Inverse
- Intertap Time Delay
- Four Settings Profiles
- Selectable Outputs, Continuous or Pulsed
- Reverse Power Operation with eight control selections including a distributed generation mode and Smart Reverse Power Operation with two Auto Determination modes
- CT to VT Phasing Correction
- Real-Time Metering of measured and calculated parameters (Single/Three-Phase)
- Demand Metering with selectable time interval
- Drag Hands Operation
- Adjustable Line Overcurrent Tapchange Inhibit
- Voltage Limits
- Tap Position Limits
- Auto Runback (due to overvoltage)
- Auto Runup (due to undervoltage)
- Three independent Voltage Reduction Steps
- Smart Voltage Reduction
- Fast Voltage Recovery
- Sequential and Non-Sequential Operation
- VT Ratio Correction
- Self-Test Alarm Output Contacts
- User Programmable Alarm Contacts
- Tap Position Knowledge by:
  - Contact KeepTrack™
  - Shaft Coupled KeepTrack™
  - Resistor Divider KeepTrack™
  - Motor Direct Drive KeepTrack™
- Operations Counter
- Resettable Operations Counter
- Tap Position Record
- Auto/Off/Manual Switch Status via SCADA
- A or B Regulator Type Selection
- Control Voltage Input
- Motor Power Input
- Source Voltage Input
- Line Current Input
- Raise Output
- Lower Output
- Motor Current Profiling
- Up to 30 unique 15 character User Access Codes (Level 1 or Level 2)
- 20 Character by 2 Row LCD or optional Vacuum Fluorescent Display
- “Hot Buttons” provide quick access to setpoints, configuration and communications
- TCC600 Communications Software
- Adapter Panel Auto/Manual Switch Manual control outside of microprocessor
- Front USB 1.1 Communications Port
- External Inhibit of Auto Tapchange
- Circulating Current Input with Circulating Current, optional ΔVAR® Paralleling Methods including Peer to Peer ΔVAR Paralleling, and optional Master/Follower (peer to peer) Paralleling (requires Ethernet)
- Front Panel LEDs for Out-of-Band Raise, Out-of-Band Lower, Reverse Power Flow Rev Pwr Detected, ALARM in effect, Voltage Reduction V/RED in Effect, CPU OK, Auto Operation Block MANUAL, SCADA Control blocked LOCAL and Com1 TX and RX
- Front-Panel Voltage Reduction 1 & 2 Inputs as well as (Binary) inputs (3 Steps Total)
- Neutral Position Detect (Binary) and Counter
- Counter Input (Binary) for Regulator applications/Complete Sequence Input for Transformer applications
- Seal-in/Switch Status Input (Binary)
- Motor Seal-In Block/Alarm
- Non-Sequential/SCADA Block Input (Binary)
- Seal-in Output (Cooper Applications)
- COM1 (top), RS-485 and Fiber Optic Port (ST and V-pin connectors available with 62.5 and 200 micro fiber supported)
- COM2 (top), RS-232 and optional Bluetooth® (user selectable if Bluetooth is installed)
- Communication Protocols include DNP3.0, MODBUS® and IEC 61850 (IEC 61850 only available with optional ethernet port)
- Smart Flash SD Card Slot supporting SD and SDHC SD cards
- Smart Flash SD Card can be linked to one or multiple controls providing a physical security “Key” which provides Level 2 User Access to the control when the SD Card is inserted for settings manipulation
- Supports Station and Feeder Level DNP addressing in addition to individual addressing for Smart Grid applications
- One pushbutton access to user configurable Wakeup screen for manual data recording with Smart Flash SD Card saving feature
- Power Quality which consists of:
  - Sequence of Events Recorder (132 events)
  - Data Logging
  - Harmonic Analysis
  - Oscillography
  - CBEMA monitoring to detect sags and swells and trigger data collection and alarming functions
- TapPlot® Oscillograph Data Analysis Software
- Individual Tap Wear Alarm
- Run Through Neutral, Automatic reversing switch swiping
- Remote Voltage Bias

Optional features

- Ethernet Port COM3 (10/100 BaseT) is available through a RJ45 jack or ST Fiber on the top of the control. This port supports DNP over TCP/IP, MODBUS® over TCP/IP, and IEC 61850 over TCP/IP
- Local Wireless Bluetooth capability
- Vacuum Fluorescent Display (rated -40 to +80 degrees Celsius)
- Control Power Back-Up Input – input (+12 Vdc) for backup of Fiber Optic communication loop-through
- IEC 61850 Communications
- ΔVAR® Paralleling:
  - ΔVAR1
  - ΔVAR2
  - ΔVAR2 KeepTrack
  - ΔVAR Peer to Peer
  - Master/Follower Paralleling (peer to peer)

Accessories

- M-2025B(D) 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

Feature information

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 –72 V to +72 V in 1 V increments. Z compensation available with adjustment of voltage raise from 0 V to +72 V, in increments of 1 V.

Time Delay: Definite; adjustable from 1 second to 360 seconds, in 1 second increments. Inverse; adjustable from 1 second to 360 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: If Motor Direct Drive KeepTrack™ is applicable, unit may be set to “Block”, “Regulate Forward (Ignore)”, “Regulate Reverse”, “Return to Neutral”, “Regulate Reverse (Measured)” or “Distributed Generation.” The Regulate Reverse feature allows separate setpoints and regulation in the reverse direction without the installation of source-side VTs. Distributed Generation allows alternate LDC R and X values to be applied to the control when reverse power is detected. If Motor Direct Drive KeepTrack is disabled, then “ Regulate Reverse (Measured)”, “Ignore” and “Block” modes are available. Regulate Reverse (Measured) allows the control to switch its voltage sensing input from a load side VT to a source side VT if one is available and operate in Reverse Power Mode using that input.

Smart Reverse Power (Auto Determination)
For reverse power conditions requiring more than one reverse power mode depending on the cause of the reverse power condition; either Distributed Generation mode or Regulate in Reverse Measured. The TCC300 provides two new reverse power modes, “Auto Determination” and “Auto Determination Measured” which allow the control to intelligently choose which reverse power mode applies at the time reverse power is sensed.

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

Load Overcurrent Tapchange Inhibit: Adjustable from 50 mA to 640 mA of line current for 200 mA CT or 0.2 A to 3.2 A for 1 A CT display and 1.2 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, Runback and Runup: 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 Runback deadband (above the overvoltage limit) of 1 V to 4 V is available, which is used to set the runback limit. Additionally, an adjustable Runup deadband (below the undervoltage limit) of 1 V to 4 V is available, which is used to set the runup limit.

Voltage Reduction: Three independent steps, each adjustable from 0% to 10% in 0.1% increments of the bandcenter setpoint can be actuated from the dedicated front-panel pushbutton or through contact inputs. Voltage Reduction can be disabled locally and remotely if desired.

Normalizing Voltage: A Normalizing Voltage Multiplier with a range of 0.80 to 1.20 is available to be applied to Meter Out Voltage and displayed in real time as Normalizing Voltage. The purpose of the Normalizing Voltage is to allow the user to overcome differences in the ratio of the PT that the Load Voltage input is using versus the PT the end user or other metering methods are using.

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

Non-Sequential/SCADA Block Operation: Non-sequential/SCADA Block blocks automatic tapchanger operation in response to external contact closure or software setting. Non-sequential/SCADA Block input also 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 M-0115A Parallel Balancing Module. Consult with factory for use with existing external master-follower circuitry.

ΔVAR® (optional): When selected, 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.

Master/Follower (Optional): The optional Master/Follower feature employs GOOSE messaging to provide peer to peer communications.

ΔVAR Peer to Peer (Optional): Paralleling achieved through

communication using GOOSE messaging.

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:

- Communication Block
- Block Raise Limit
- Block Lower Limit
- Backup Fail (if purchased)
- Voltage Reduction
- Reverse Power Flow
- Line Current Limit
- Individual Tap Wear
- Tap Block Raise
- Tap Block Lower
- LDC/LDZ
- Op Count Signal
- Abnormal Tap
- VAr Bias Lag
- VAr Bias Lead
- RTN Fail to Operate
- Tap Changer Failure

Tap Position Knowledge
Current Loop Method: The optional M-2025D Current Loop Interface Module receives a signal from a position transducer and provides an input to the TCC300 through a six pin port.

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

Transformers: The control includes two additional methods of Tap Position Knowledge, Contact KeepTrack™ “1R1L” and “1N”. These methods utilize re-assigned voltage reduction VR1 and VR2 inputs as Raise and Lower contact inputs respectively. These inputs cause the controls “KeepTrack™” tap position status to increment.

Operation 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. When a Cam Follower contact input is wired into the Counter contact input of the TCC300, the operation counter will increment when the counter input sees the cam follower open and then close.

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

Tap Position Record: Provides a record of the number of times each tap position has been passed through. The tap position record can be reset by the user.

Tap Wear Settings: Provides the capability to determine tap wear in a regulator’s tap change mechanism.

Auto/Manual Switch Status: Provides the user with the Auto/Manual switch position status through the Comm ports. When the TCC300 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 or optional IEC 61850 protocol) to the control. The SCADA HeartBeat feature can be enabled from TCC600 Communications Software. There are four different types of SCADA HeartBeat modes that can be selected:

- SCADA HeartBeat for transformer control applications (LTC)
- SCADA HeartBeat for regulator control applications (Regulator)
- Profile Switching – This mode allows the user to specify a different settings profile to operate by while communication is active
- Profile Switching (GOOSE) – with the optional IEC 61850 protocol

SCADA Remote Manual Mode: The purpose of the SCADA HeartBeat Remote Manual Mode is to provide a means for a SCADA system to place the unit in Remote Manual and perform Raise and Lower operations. As long as a Remote Manual Timer setting in the control is refreshed by the SCADA system before it times out, the control will stay in Remote Manual. If the timer times out, the control reverts to normal Automatic operation.

VAr Bias: This feature is intended but not restricted for use with distribution feeders which have switched capacitor banks controlled by M-2501 series Autodaptive® Capacitor Controls. Use of VAr Bias allows the TCC300 to coordinate it’s operation with the M-2501 series Autodaptive Control devices on the distribution system in order to minimize losses, smooth the voltage profile and optimize VAr flow.

Optional Bluetooth: The optional Bluetooth® (V2.0 +EDR Class 1 Type) provides wireless access to the TCC300. With Bluetooth the user is able to configure the control, read status and metering values as well as change setpoints. This option can be field installed. There are two modes of operation for the Bluetooth:

Mode 0 – The device is discoverable and connectable to any client station.

Mode 1 – The device is non-discoverable but it is connectable to any client station who knows the control Bluetooth device address indicated under “Control BT Device” in the HMI.

Mode 1 – Has been added to meet CIP requirement. (CIP-0007-4 System Security Management) (R2.3)

Source Side PT Input: The Source Side PT Input feature provides for Reverse Power regulation with measured source side voltage. This mode consists of energizing a contact relay when reverse power is sensed which will switch the analog voltage input from the load side to the source side. Voltage regulation will then operate on the new measured source side voltage instead of the traditional source side voltage.

SCAMP: (SCADA Controllable Auto/Manual Pushbutton) switch allows the Auto/Manual state on an adapter panel to be changed by a SCADA command.

Monitoring/Metering

Real-Time Metering: The following single/three-phase measured and calculated values are available in real-time:

- Primary Voltage
- Meter Out Voltage
- Source Voltage
- Tap Position
- Primary Source Voltage
- Compensating Voltage
- Drag Hands
- Primary Current
- Normalizing Voltage
- Raise/Lower Timer
- Primary Watts
- Load Current
- Intertap Timer
- Primary VAr
- Power Factor
- Operation Counter
- Primary VA
- Frequency
- Resettable Counter
- Load Voltage
- Circulating/ΔVAr Current
- Neutral Counter
- RTN Status
- Count to RTN Active
- RTN Success Counter
- Remote Voltage Bias

Present Demand: The Present Demand feature captures the maximum values during the specified time interval. Time interval can be selected as 5, 10, 15, 30, or 60 minutes.

- Demand Load Voltage
- Demand Primary Current
- Primary Watts
- Primary VArs
- Primary VA

Demand History (Drag Hands Operation): The following "drag-hand" values are stored with date and time stamping and are averaged over 32 seconds:

- Min Load Voltage
- Max Load Voltage

The following "drag-hand" values are stored with date and time stamping and are calculated over the demand time interval (5, 10, 15, 30, or 60 minutes) as selected by the user:

- Max Primary Current (Amps)
- Max Primary VArs (kVAr or MVAr)
- Max Primary Watts (kW, or MW)
- Max Primary VA (kVA or MVA)
- Power Factor @ Max VA

Energy Metering:
The following measured values are retained in non-volatile memory. A real time clock is utilized to record a date/time stamp for each quantity to indicate when the period of measurement was initiated.

- Watt Hours Forward (kWh)
- Lagging VAr Hours (kVArh)
- Watt Hours Reverse (kWh)
- Leading VAr Hours (kVArh)

Power Quality

Sequence of Events: The Sequence of Events recorder provides comprehensive data recording (of voltage, current, frequency, etc.). Sequence of Events data can be downloaded using the communications ports to a PC running TCC600 Communications Software. The unit can store up to 132 events in a first in/first out memory scheme.

The Sequence of Events can be triggered by the status change of any of the following signals:

- Raise Contact
- Lower Contact
- Voltage Reduction 1
- Voltage Reduction 2
- Force Lower
- Raise Tap Limit
- Lower Tap Limit
- Low Band
- High Band
- Low Voltage Limit
- High Voltage Limit
- Auto Inhibit
- Non-sequential
- Reverse Power
- Peak Motor Current
- Avg. Motor Current
- Motor Current Duration
- Voltage Harmonics
- Current Harmonics
- CBEMA Event 1
- CBEMA Event 2
- CBEMA Event 3
- CBEMA Event 4
- VAr Bias Active
- Sealin Fail Alarm Active
- Sealin Fail Low Blk Act
- Sealin Fail Raise Blk Act
- Low Current Blk Active
- Motor Seal-in Input
- Neutral Input
- Counter Input
- Op Count Signal
- HMI Active
- Individual Tap Wear Alarm

Oscillograph Recorder: The Oscillograph Recorder provides comprehensive data recording (voltage, current, and status input/output signals) for all monitored waveforms (at 16, 32 or 64 samples per cycle). Oscillograph data can be downloaded using the communications ports to any personal computer running TCC600 Communications Software. Once downloaded, the waveform data can be examined and printed using the TapPlot® Oscillograph Data Analysis Software.

Harmonic Analysis: Provides the total harmonic distortion and the harmonic content of the load voltage and current up to the 31st harmonic.

Data Logging: A built-in data logging recorder that continually records data in non-volatile memory. Data Logging will continue indefinitely as long as the data interval is set to a non-zero value.

- Load Voltage
- Compensated Voltage
- Primary Watts
- Primary VA
- Primary VAr
- Load Current
- Power Factor
- Line Frequency
- Tap Position
- Source Voltage
- Primary Current
- Operation Counter
- Circulating/ΔVAr Current
- Meter Out Voltage
- RTN Counter

CBEMA: Monitoring to detect sags and swells, trigger data collection and alarming functions.

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 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.

Optional Control Power Backup Input: (Two pin Molex connector on the top 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. See M-2026/M-2027 Companion Control Power Backup Supplies later in the specification.

Source Side PT Input: Nominal 120 Vac, 60 Hz (50 Hz optional). 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.

Binary Inputs

Voltage Reduction 1 & 2 Inputs: These inputs provide three levels of programmable voltage reduction which can be manually invoked. The Voltage Reduction 2 Input can also be programmed as an auxiliary input with a DNP status point affiliated with it.

Neutral Position Detect: The Neutral Position Detect Input detects the neutral tap position, which assists the Motor Direct Drive KeepTrack™ tap position function. This Neutral Position Detect Input also facilitates disabling the paralleling mode ΔVAR®2 (KeepTrack™).

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. Also, when the Contact KeepTrack™ "1R1L" method is selected the Counter Input functions as a 1L tap connection input. 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 Block 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 Block 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 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 6 A at 120 Vac or 100 mA at 120 Vdc.

Run Through Neutral

The control includes a Run Through Neutral (RTN) feature that when enabled counts tapchanger operations and when user settable settings are met, drives the tapchanger through the neutral position to swipe the reversing switch to prevent contact buildup and coking.

Remote Voltage Bias

The Remote Voltage Bias feature is similar to Load Drop Compensation (LDC) in that it uses a remotely monitored voltage obtained by the control (through either DNP 3.0, MODBUS, or IEC 61850 protocol) to bias the Bandcenter of the control. A Remote Voltage Heartbeat Timer is utilized to initiate the Bandcenter Bias and when it expires the control reverts back to the existing settings.

Front Panel Controls

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

The TCC300 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.

Smart Flash SD Card Slot

Allows the user to perform the following functions:

- Load Setpoints
- Save Setpoints
- Save Data Log
- Save Sequence of Events
- Save Oscillograph Records
- Clone Save
- Clone Load
- Load DNP Config
- Save DNP Config
- Firmware Update
- Save Metering Data
- Save/Load IEC 61850 CID Files
- User Access Key Code
- Save Wakeup Screen Parameters
- Quick Capture

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**, **ALARM** 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 alarm contact capable of switching 6 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 ±0.3 % when tested in accordance with the IEEE C57.15.9-2009 standard over a 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 Windows™ based computer running TCC600 Communications Software or SCADA communications software. COM1 (top) is available with RS-485 or ST or V Pin Fiber Optics. COM2 is available with RS-232 standard or optional Bluetooth®. COM3 is an optional RJ45 or Fiber Optic Ethernet Port. A USB front port is standard for local communications with TCC600 and for software updates.

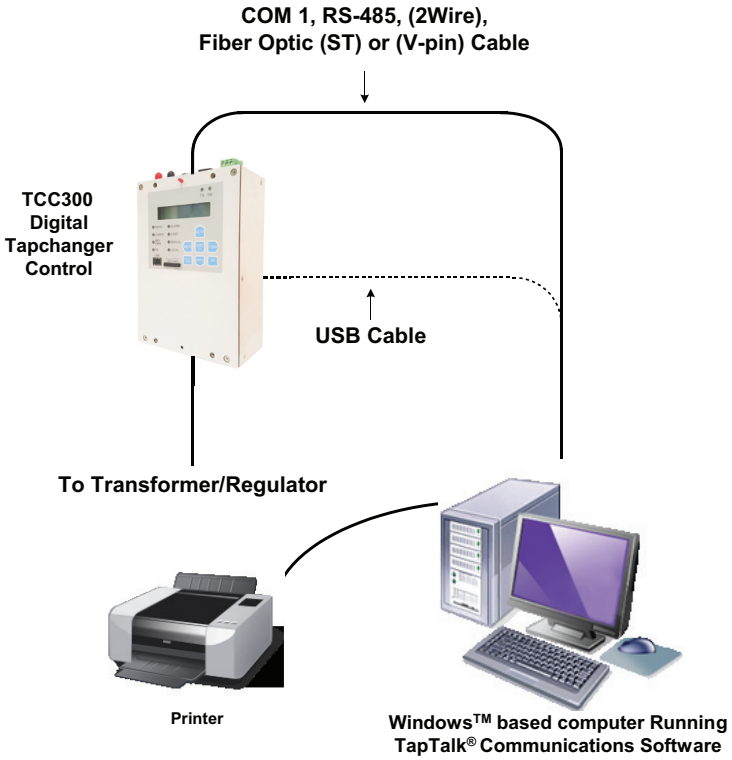
Protocols: The following standard protocols are included in COM1/COM2/COM3: DNP3.0, MODBUS®, and IEC 61850 (when used with the optional ethernet port). The USB port uses MODBUS for local communications.

Communications Via Direct Connection: TCC600 supports direct communication (MODBUS protocol) with a TCC300 using the applicable connector (USB cable) for the PC, or Fiber Optic communication using ST standard or V-pin, or two-wire RS-485.

Optional Ethernet Port: An optional Ethernet 10/100 Mpbs Port (COM3) is available through an RJ45 or Fiber Optic Ethernet Port on the top of the control. This port supports DNP over TCP/IP, MODBUS over TCP/IP, and IEC 61850 over TCP/IP. Also, SNTP (Simple Network Time Protocol) Protocol is available to synchronize the control's RTC clock with the network server.

Optional Bluetooth: The optional Bluetooth provides wireless access to the TCC300. With Bluetooth the user is able to configure the control, read status and metering values as well as change setpoints using TCC600 Communication Software.

Figure 1. Direct connection



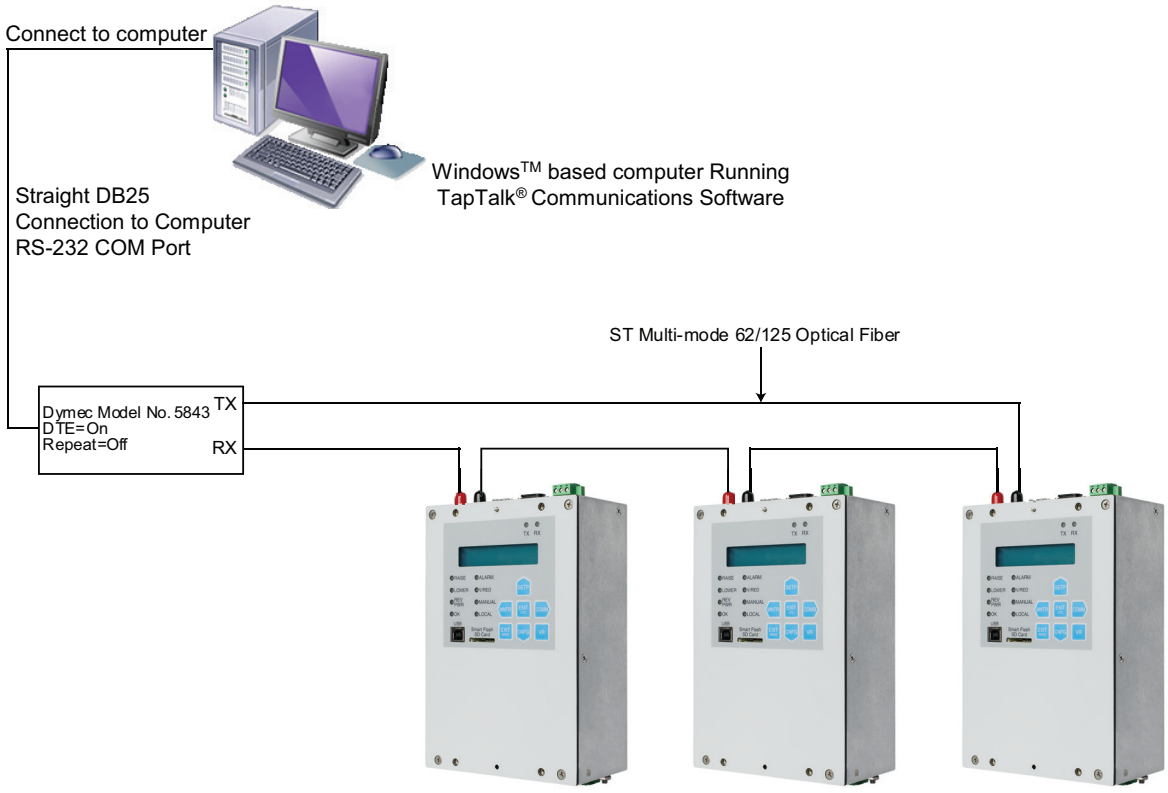
Communications Using Networking: The addressing capability of the TCC300 allows networking of multiple ABB Digital Tapchanger Controls. Each tapchanger control can be assigned a Communications Address, Feeder Address or Substation Address ranging from 1 to 65519. Selected commands may be broadcast to all controls on the network. Figures 2, 3 and 4 illustrate typical network configurations. Addresses 1 to 247 can be assigned to MODBUS® and 1 to 65519 for DNP3.0.

Application: Using a Windows™ based computer or wireless modem, the operator has real-time, remote access to all functions of the 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 tapchange 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 tapchange operations
- Re-configuration of the control, such as a change to the demand integration time period or a selection of different alarm parameters
- Unsolicited exception reporting multicast capability using UDP and TCP
- DNP file transfer of Data Logging, Oscillography and Sequence of Events records

Unit Identifier: A 2-row by 20-character alphanumeric sequence, set by the user, can be used for unit identification.

Figure 2. Fiber Optic Connection Loop (optional V-pin connection available)



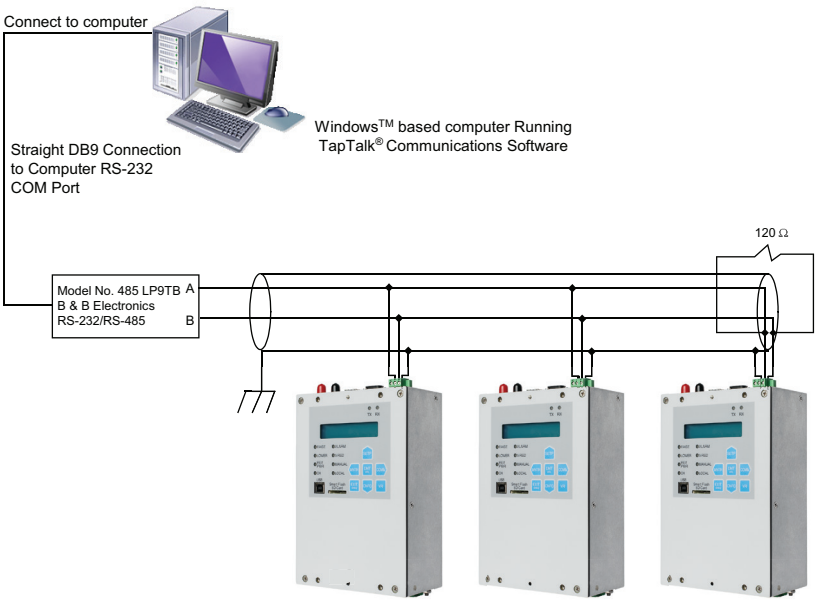


Figure 3. RS-485 Network Connection

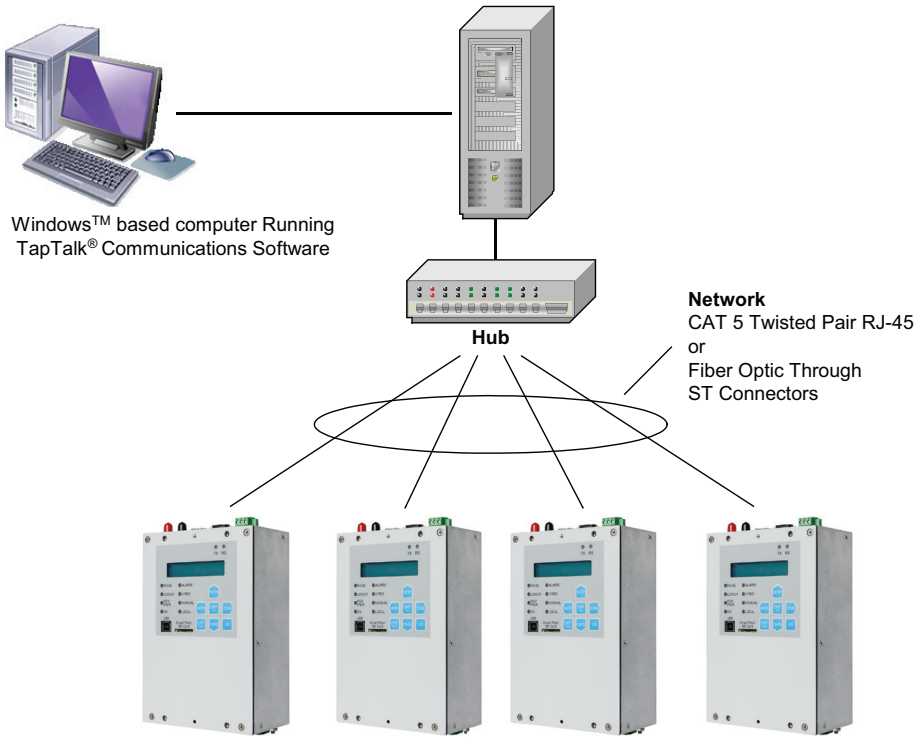


Figure 4. Ethernet Network Connection

Tests and Standards

TCC300 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 µs, 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 (±15kV)–air discharge

Fast Transient Disturbance Test	
IEC 60255-22-4	Class A (±4 kV, 2.5 kHz, 5 kHz)

Surge Withstand Capability	
ANSI/IEEE C37.90.1-1989	2,500 V pk oscillatory applied to each independent circuit to earth
	2,500 V pk oscillatory applied between each independent circuit
	5,000 V pk Fast Transient applied to each independent circuit to earth
	5,000 V pk Fast Transient applied between each independent circuit
IEEE C37.90.1-2002	2,500 V oscillatory applied to each independent circuit to earth
	2,500 V oscillatory applied between each independent circuit
	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

Radiated Field Immunity	
IEEE C37.90.2	80 MHz - 1000 MHz @ 35 V/M
IEC 60255-22-3	80 MHz - 2700 MHz @ 10 V/M

Conducted Field Immunity	
IEC 60255-22-6	150 kHz - 80 MHz @ 10 V emf

Atmospheric Environment

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

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

IEC 60068-2-1	Cold, –40° C
IEC 60068-2-2	Dry Heat, +85° C
IEC 60068-2-78	Damp Heat, +40° C @ 95% RH
IEC 60068-2-30	Damp Heat Condensation Cycle, 25° C, +55° C @ 95% RH

Mechanical Environment

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

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 TCC300 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

Size: 5 13/16” wide x 8 1/2” high x 3 1/8” deep (10.81 cm x 21.6 cm x 7.94 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 TCC300 Tapchanger Control is covered by U.S. Patent 5,581,173.

The TCC300 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 ten-year warranty from date of shipment.

Specification subject to change without notice.

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

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

Table 1. M-2948 Model Application Information

Sensor	Rotation range	Degrees/tap	Taps	Neutrals	Rotation/slope
M-2948-91N	0 – 297°	9°	±16	1	Negative
M-2948-91P	0 – 297°	9°	±16	1	Positive
M-2948-92N	0 – 306°	9°	±16	2	Negative
M-2948-92P	0 – 306°	9°	±16	2	Positive
M-2948-93N	0 – 315°	9°	±16	3	Negative
M-2948-93P	0 – 315°	9°	±16	3	Positive
M-2948-11N	0 – 330°	10°	±16	1	Negative
M-2948-11P	0 – 330°	10°	±16	1	Positive
M-2948-12N	0 – 340°	10°	±16	2	Negative
M-2948-12P	0 – 340°	10°	±16	2	Positive
M-2948-13N	0 – 350°	10°	±16	3	Negative
M-2948-13P	0 – 350°	10°	±16	3	Positive

NOTE: Tap Position Sensors are available with either a positive “P” or negative “N” slope. Negative slope (clockwise rotation) causes a decrease in Tap Position. Positive slope (clockwise rotation) causes an increase in Tap Position.

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 297, 306, 315, 330, 340 and 350 degrees respectively for 32 taps and up to three neutral positions. 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 ABB 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).

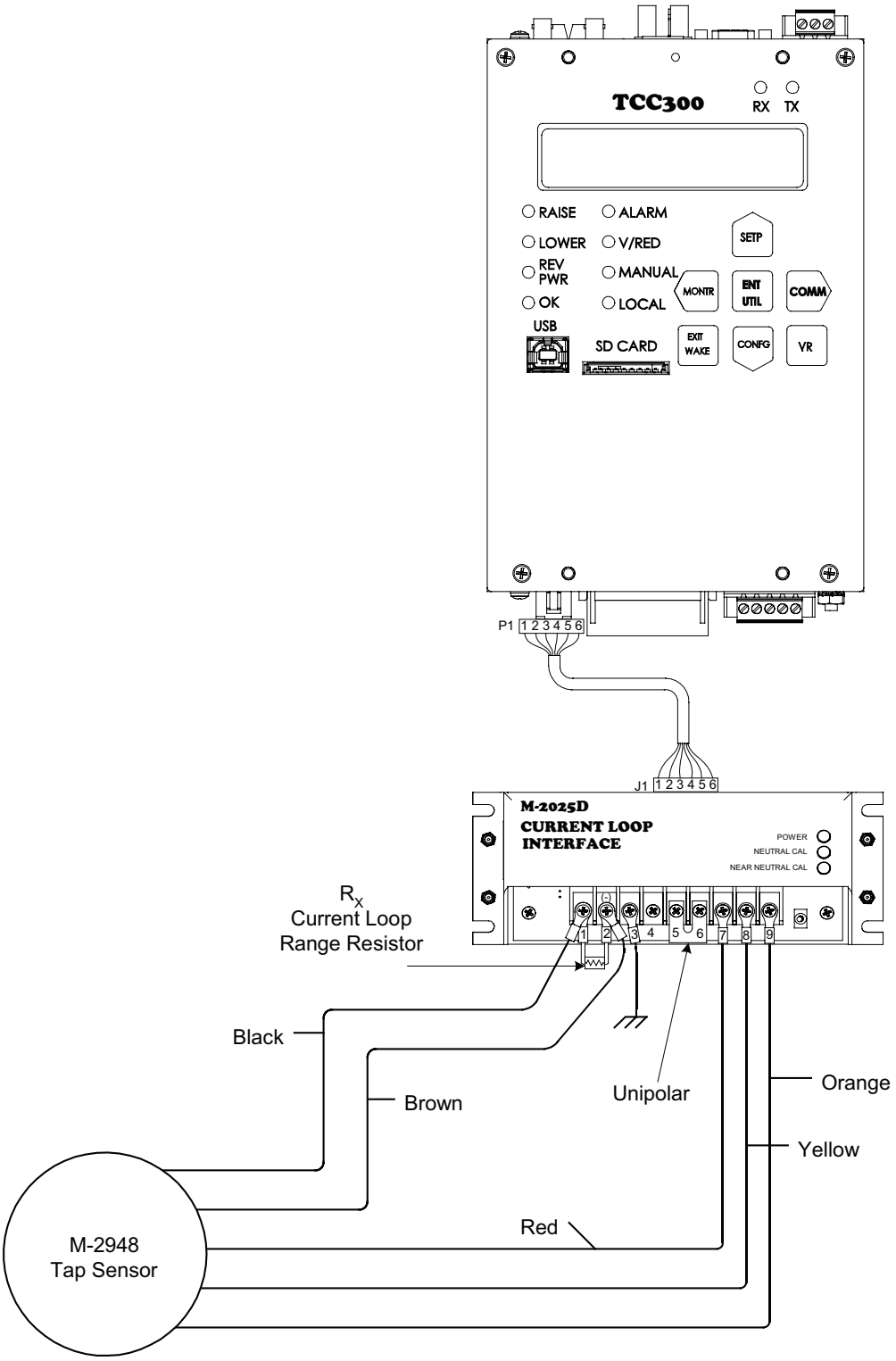


Figure 5 Typical M-2025B(D) External Tap Position Interface with M-2948 Tap Position Sensor

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 Control Power Backup Supply will accept either an AC or DC input over the following ranges:

- 21 to 32 V
- 42 to 60 V
- 105 to 145 V

Note: It must be ordered in the input range needed.

The M-2026 will output a regulated +12 Vdc (±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 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-weather-tight enclosure and equipped with screw terminal blocks for input and output connections.

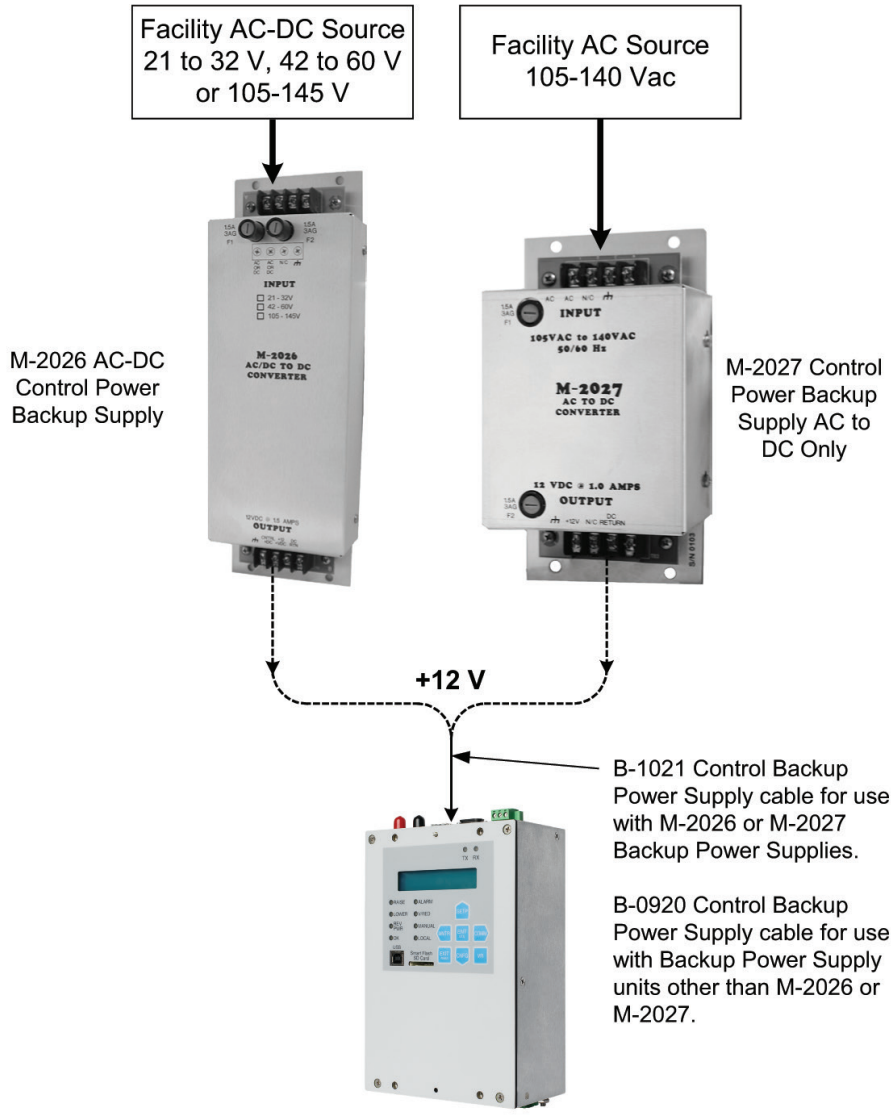


Figure 6. Typical M-2026/M-2027 Control Power Backup Supply Application

TCC300 Digital Tapchanger Control order worksheet

Smart model number:	TCC300	*	*	*	*	*	*	*	*	*
TCC300 digital voltage regulator control										
TCC300 Digital voltage regulator control	TCC300									
Operating frequency										
50 Hz		5								
60 Hz		6								
Display options										
LCD Display -20° to +70° C			L							
Vacuum Fluorescent Display -40° to +80° C			V							
COM-1 SERIAL COMMUNICATIONS										
RS-485 & ST Fiber Optics				4S						
RS-485 & V-Pin Fiber Optics				4V						
COM-2 serial communications										
RS-232					20					
RS-232 & BlueTooth®					2B					
Ethernet selection										
None						0				
RJ-45 Copper Wire connector 10/100 Base-T						C				
Fiber Optic ST Connector 100 Base-FX						F				
Protocol selection										
None (MODBUS & DNP Standard)							0			
IEC-61850 Protocol - Requires Ethernet Com Port							U			
Paralleling methods										
Standard Circulating Current								S		
ΔVAr™ and ΔVAr 2 Paralleling								D		
P2P, Master/Follower Paralleling, and ΔVar from above - Requires Ethernet								P		
Other options										
None									0	
Backup Control Power Input for fiber optic com-port									B	
Customer requirements										
None										0
Customer Specific Requirements (please write requirements below)										X

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