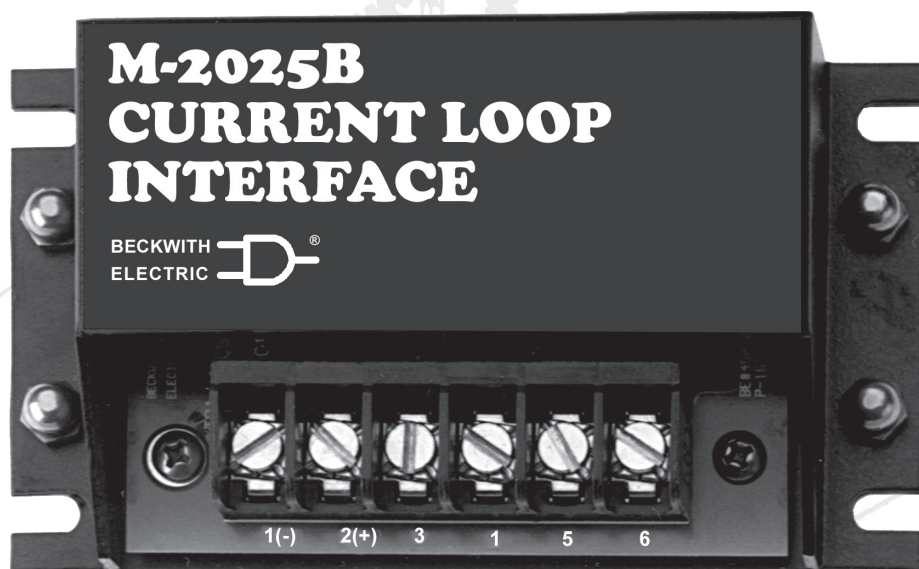# BECKWITH ELECTRIC ®

Current Loop Interface Module M-2025B

Current-to-Voltage Analog Converter used with the M-2001 Series Digital Tapchanger Controls and earlier models to provide positive tap position knowledge

- Connects easily to the M-2001 Series Digital Tapchanger Control using a 6-pin connector

- Provides a 6-position terminal block for easy connections

- Enclosed components permit user to select one of four current range configurations

- Small size permits mounting on any flat surface at least 4–5/8" wide and 2–5/8" high

HUBBELL ®

The M-2025B Current Loop Interface Module is a current-to-voltage analog converter that is used with a suitable analog position-to-current transducer and the M-2001 series of Digital Tapchanger Controls to provide positive tap position knowledge of an LTC transformer or regulator. Components required to configure the M-2025B and interface with the M-2001 are included.

Current Loop Configuration

The configuration to use Tap Position by Positive Knowledge (Current Loop) Procedure is shown in the figure below and typically includes:

- Tapchanger position output (shaft movement)
- Selsyn™ Transmitter (Selsyn is a trademark of the General Electric Corporation)
- Tap Position Monitor
- M-2025B Current Loop Interface Module
- M-2001 Series Digital Tapchanger Control

■ **NOTE:** Means other than a Selsyn transmitter and tap position monitor are available to produce the required current loop output signal.
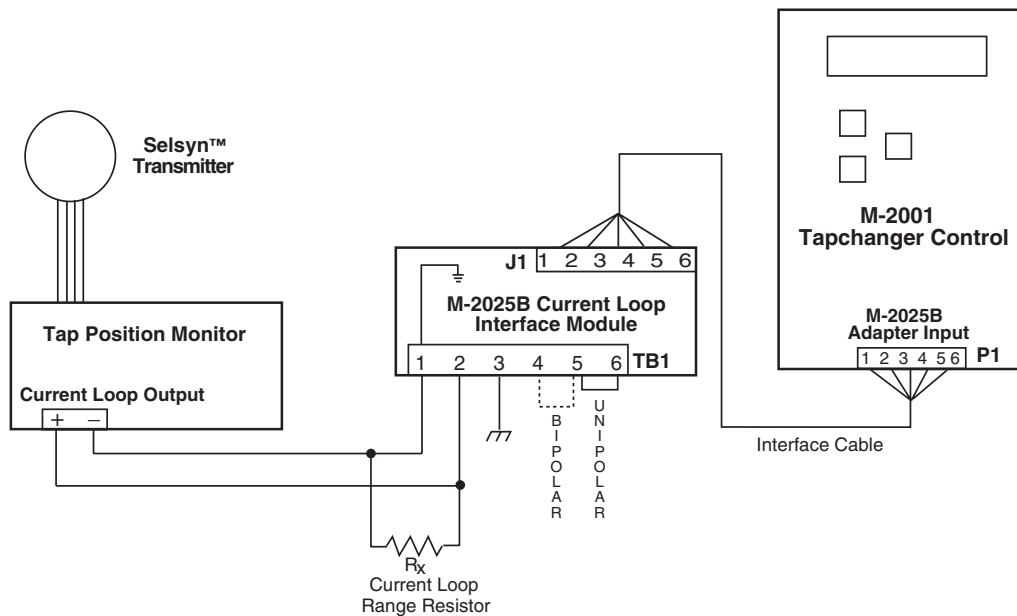

Figure 1   Typical External Tap Position Interface

Tapchanger Position Output (Shaft Movement): Most LTC tapchangers have an output shaft whose angular rotation and position are a mechanical analog to the tapchanger tap position. In many cases, the total range of tap positions is represented by one or two rotations of this shaft.

Selsyn™ Transmitter: This transmitter is mechanically connected to the tapchanger position output shaft. The Selsyn transmitter is an electromagnetic device used for transmitting data on rotational position. Selsyns, or synchros, as they are sometimes called, resemble small electric motors. They have various configurations of internal windings. One or more windings are on a rotor and usually three windings (stator), are stationary surrounding the rotor. By exciting the rotor windings with an AC signal, induced voltages in the stator windings can be compared in amplitude and polarity to determine the angular position of the rotor, relative to the stator windings.

Tap Position Monitor: This device compares voltages from the stator windings of the Selsyn transmitter to determine the rotor position. The position information is converted to a tap position number and is usually displayed on the front of the unit. This device includes an analog current output that corresponds to the displayed tap position. The M-2025B Current Loop Interface Module will accept a current of one of four options:

  • 0 to 1 mA dc   • 0 to 2 mA dc   • -1 to +1 mA dc   • 4 to 20 mA dc

The lowest current value corresponds to the lowest tap number; the highest current value to the highest tap number.

Beckwith Electric M-2025B Current Loop Interface Module: This device accepts the current loop output and properly scales it by the use of an external resistor. It also is configured by a wire jumper to select a unipolar or a bipolar current loop input. It provides an analog voltage output to the M-2001 Series Control that tracks the analog current output of the Tap Position Monitor. The lowest analog dc voltage corresponds to the lowest tap position number and the highest dc voltage corresponds to the highest tap position number.

Resistors to support current range selection, jumper wire to select current loop input and an Interface Cable (Beckwith Electric Part Number B-0753) are provided with the M-2025B module.

Beckwith Electric M-2001B(C, D) Digital Tapchanger Control: The M-2025B Current Loop Interface Module connects to the M-2001B(C, D) through the B-0753 interface (6 pin to 6 pin) cable. The M-2001B(C, D) provides low-voltage dc to power the M-2025B and accepts an analog voltage input as described above. The M-2001B(C, D) has a tap calibration screen to establish a reference tap position and a tap position display screen to digitally display the current tap position. The B-0753 interface cable is available in 3, 6, 8, 12, 15, and 25 foot lengths.

Beckwith Electric M-2001, M-2001A or M-2001A-1 Tapchanger Control: The M-2025B Current Loop Interface Module connects to the M-2001, M-2001A, or M-2001A-1 through the B-0752 interface cable (5 pins on one end and 6 pins on the other end). These controls provide low-voltage dc to power the M-2025B, and accept an analog voltage input as described above. They also have a tap calibration screen to establish a reference tap position and a tap position display screen to digitally display the current tap position.

M-2025B Current Loop Interface Module Configuration

The M-2025B can be configured for one of four current ranges: 0 to 1 mA, 0 to 2 mA, –1 to 1 mA, or 4 to 20 mA. The current range is set by the use of an external resistor and a jumper which are provided with the M-2025B. The current ranges are set as follows (TB1 refers to the M-2025B terminal block):

Current Range	Resistor	Beckwith Electric Part Number	Jumper Position
0 to 1 mA	3.01 KΩ	B-1786-03	TB1-5 to TB1-6
0 to 2 mA	1.5 KΩ	B-1786-02	TB1-5 to TB1-6
4 to 20 mA	150 Ω	B-1786-01	TB1-5 to TB1-6
-1 to 1 mA	1.5 KΩ	B-1786-02	TB1-4 to TB1-5

Table 1   Resistor Selection Table

Configure the M-2025B by performing the following:

1. Select the correct resistor from the above table for the desired current range.

2. Connect the resistor between TB1-1 and TB1-2.

3. Connect the positive side of the current loop to TB1-2.

▲**CAUTION:** Internally, TB1-1 is connected to ground. The current loop circuit must **NOT** be grounded elsewhere as damage to current loop components may occur.

4. Connect the negative side of the current loop to TB1-1.

5. Connect the provided jumper between TB1-5 and the appropriate TB1 connection, as determined from the **Resistor Selection Table**.

6. Connect the proper interface cable (B-0753 for M-2001B(C, D), B-0752 for all others) as follows:

    a. For M-2001B(C, D), ensure that the conductor end key tab is pointing toward the front of the M-2001B(C, D), then connect the six conductor cable between connector J1 of the M-2025B and P1 on the bottom of the control.

    b. For M-2001, M-2001A, or M-2001A-1, ensure that the five-conductor end key tab is pointed towards the front of the tapchanger control. Then connect the five-conductor cable end to P1 on the bottom of the tapchanger control and the six-conductor cable end to J1 of the M-2025B.

7. Connect TB1-3 to an appropriate earth ground.

M-2001 Series Digital Tapchanger Control Configuration

The M-2001 configuration menu provides a selection screen to disable or to select whether the M-2001 uses the Contact KeepTrack™, Shaft Coupled KeepTrack™, Resistor Divider KeepTrack™ or Motor Direct Drive KeepTrack™ method for tap position knowledge. The correct current range must be selected in this M-2001 configuration menu.

From Configuration menu

```
TAP INFORMATION

XFMR EXTERNAL#1
```
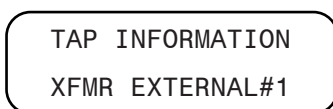
The following table outlines the ten selections available on the **TAP INFORMATION** screen.

Screen Selections	Tap Position Knowledge Method	Current Range	Screens Disabled
XFMR EXTERNAL #3	Current Loop	0 to 1 mA	Primary & Secondary Source Voltage
XFMR EXTERNAL #2	Current Loop	4 to 20 mA	Primary & Secondary Source Voltage
XFMR EXTERNAL #1	Current Loop	0 to 1, 0 to 2, or ±1 mA	Primary & Secondary Source Voltage
REG EXTERNAL #3	Resistor Divider	Not Applicable	None
REG EXTERNAL #2	Current Loop	4 to 20 mA	None
REG EXTERNAL #1	Current Loop	0 to 1, 0 to 2, or ±1 mA	None
INTERNAL KEEPTRACK	Motor Direct Drive KeepTrack	Not Applicable	None
CONTACT KT 1R1L	Direct Contact KeepTrack	Not Applicable	Primary & Secondary Source Voltage
CONTACT KT 1N	Direct Contact KeepTrack	Not Applicable	Primary & Secondary Source Voltage
DISABLE	None	None	Primary & Secondary Source Voltage, Tap Position

Table 2   Tap Information Screen Selections

■ **NOTES:**

1. When using a resistance to current transducer with an internal tap, fitted to supply a current loop to the M-2025B, the **XFMR EXTERNAL#3** selection in the **TAP INFO** menu must be selected (e.g., Crompton Instruments® model 253-TRTU, 1–17 taps, 400 W each, 1 internal tap fitted).

2. **XFMR EXTERNAL#3, XFMR EXTERNAL#2** and **XFMR EXTERNAL#1** selections may only be used in transformer control applications.

3.   **REG EXTERNAL#2**, **REG EXTERNAL#1** and **REG INTERNAL** selections may only be used in regulator control applications.

4.   The **DISABLE** selection may be used for either regulator control or transformer control applications.

The following procedure outlines the steps necessary to configure an M-2001 Series Digital Tapchanger Control to use positive tap position knowledge. A user who possesses Level 2 security authority will be required to program the control to select the method of tap position knowledge or to disable this feature.

■ **NOTE:** Tap ranges for the M-2001 are configurable to display a range of 33 tap positions: 16L to 1L, neutral, and 1R to 16R. These taps are proportional to the entire current range at the input of the M-2025B.

Configure the M-2001 by performing the following:

1.   Access the **TAP INFORMATION** screen in the Configuration menu.

2.   Select the tap range in **TAP MAX** and **TAP MIN** screens (range of Tap Max or Tap Min = K33). Tap Max – Tap Min <34. For example, 16R – 16L = 32; 32 + 1 Neutral = 33 taps.

3.   Select the correct method of tap position knowledge.

4.   Set Inter-tap Time Delay to a minimum of 1 second.

■ **NOTE:** When using the M 2025B Current Loop Interface Module, and Tap Limits are enabled, a one second intertap time delay should be used. This gives the control time to recognize the new tap position before a subsequent tap operation can occur. This prevents the control from driving past the established Tap Limit.

Calibration

■ **NOTE:** Calibration should be performed between the mid-range position and the top tap position, if possible.

▲ **CAUTION:** Calibration of the tap position should be *carefully checked*, as incorrect tap positioning and limiting can result in improper voltage regulation. If the tap position knowledge function is not used, the Tap Information screen *should* be set to DISABLE.

● **WARNING: Do not rely on the M-2001 display of tap position for bypassing a regulator — doing so may result in death, severe injury or damage to the regulator.**

1.   Determine the actual tap position from the mechanical tap position indicator on the LTC transformer or regulator.

2.   Scroll through the M-2001 screens to the **TAP CALIBRATE** screen in the Configuration menu.

3.   Press the **ENTER** pushbutton, a flashing **"C"** indicates that the control is ready to accept data.

4.   Press the **UP** or **DOWN** pushbutton until the correct tap position is displayed.

5.   Press the **ENTER** pushbutton, the tap position is now calibrated and the present tap position at which the tapchanger is operating is indicated in the status menu at the **TAP POSITION** screen.

6.   Verify that the tap position displayed on the M-2001 and the actual tap position agree:

•   If the tap position displayed on the M-2001 and the actual tap position agree, then the calibration is complete.

•   If the tap position displayed on the M-2001 and the actual tap position do not agree, then continue on to Step 7 to trouble shoot the control.

■ **NOTE:** The following trouble shooting steps require the use of a voltage measuring device.

7.   Verify that TB1 on the M-2025B does not contain any connections to ground.

8.   Measure and note the DC voltage across the resistor installed between terminals TB1-1 and TB1-2 of the M-2025B.

9.   Initiate a tap change either up or down, then measure and note the DC voltage across the resistor installed between terminals TB1-1 and TB1-2.

10. If the measured DC voltage does not change with a change in tap position, then examine the installed Tap Position Monitor for proper operation.

11. Measure and note the DC voltage across the resistor installed between terminals TB1-1 and TB1-2 of the M-2025B.

12. Based on the analog current output range of the installed Tap Position Monitor, determine if the measured DC voltage obtained in Step 11 matches (±1%) the DC voltage found in Table 3 for the indicated tap position.

Tap Position	0 - 1 mA Range Vdc	Bipolar 1 mA Range Vdc	0 - 2 mA Range Vdc	4 - 20 mA Range Vdc
-16	0.0000	-1.5000	0.0000	0.6000
-15	0.0938	-1.4063	0.0938	0.6750
-14	0.1875	-1.3125	0.1875	0.7500
-13	0.2813	-1.2188	0.2813	0.8250
-12	0.3750	-1.1250	0.3750	0.9000
-11	0.4688	-1.0313	0.4688	0.9750
-10	0.5625	-0.9375	0.5625	1.0500
-9	0.6563	-0.8438	0.6563	1.1250
-8	0.7500	-0.7500	0.7500	1.2000
-7	0.8438	-0.6563	0.8438	1.2750
-6	0.9375	-0.5625	0.9375	1.3500
-5	1.0313	-0.4688	1.0313	1.4250
-4	1.1250	-0.3750	1.1250	1.5000
-3	1.2188	-0.2813	1.2188	1.5750
-2	1.3125	-0.1875	1.3125	1.6500
-1	1.4063	-0.0938	1.4063	1.7250
0	1.5000	0.0000	1.5000	1.8000
1	1.5938	0.0938	1.5938	1.8750
2	1.6875	0.1875	1.6875	1.9500
3	1.7813	0.2813	1.7813	2.0250
4	1.8750	0.3750	1.8750	2.1000
5	1.9688	0.4688	1.9688	2.1750
6	2.0625	0.5625	2.0625	2.2500
7	2.1563	0.6563	2.1563	2.3250
8	2.2500	0.7500	2.2500	2.4000
9	2.3438	0.8438	2.3438	2.4750
10	2.4375	0.9375	2.4375	2.5500
11	2.5313	1.0313	2.5313	2.6250
12	2.6250	1.1250	2.6250	2.7000
13	2.7188	1.2188	2.7188	2.7750
14	2.8125	1.3125	2.8125	2.8500
15	2.9063	1.4063	2.9063	2.9250
16	3.0000	1.5000	3.0000	3.0000

Table 3   Tap Position versus Vdc Reading For Various Tap Position Monitors

13. If the measured DC voltage obtained in Step 11 does not match (±1%) the <u>Table 3</u> DC voltage for the indicated tap position, then verify that the correct resistor has been installed across the proper terminals.

14. If the measured DC voltage obtained in Step 11 matches (±1%) the <u>Table 3</u> DC voltage for the indicated tap position, then perform the following:

    a. Ensure that the interface cable is connected to the M-2001B and the M-2025B.

    b. Measure the DC voltage at the interface cable J1 connector (<u>Figure 2</u>), between pins 1 and 2. A voltage reading of approximately 12 Vdc should be present.

    c. Measure the DC voltage at the interface cable J1 connector, between pins 1 and 4. A voltage reading of approximately 8 Vdc should be present

    d. If either voltage reading does not match the above stated approximate value, then contact Beckwith Electric for further assistance.
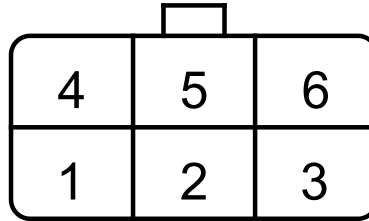

Figure 2   Interface Cable J1 Connector Pinout

Testing Specifications

High Voltage: Input terminals TB1-1 and TB1-2 will withstand 1500 Vac rms to chassis or instrument ground for one minute with a leakage current not to exceed 25 mA.

Surge Withstand Capability: Input terminals TB1-1 and TB1-2 are protected against system transients. Units pass all requirements of ANSI/IEEE C.37.90.1-1989 defining surge withstand capability.

Radiated Electromagnetic Withstand Capability: All units are protected against electromagnetic radiated interference from portable communications transceivers as outlined in ANSI/IEEE C37.90.2-1987 defining radiated electromagnetic withstand capability.

Environmental

Temperature Range: Stated accuracies are maintained from -40° to +80° C.

Humidity: Stated accuracies are maintained under 95% relative humidity (non-condensing).

Fungus Resistance: A conformal printed circuit board coating inhibits fungus growth.

Physical

Size: 2-5/8" high x 4-5/8" wide x 1-1/8" deep (6.65 cm x 11.68 cm x 2.86 cm)

Approximate Weight: 1 lb (0.45 kg)

Approximate Shipping Weight: 2 lbs (0.91 kg)

Warranty

The M-2025B Current Loop Interface Module is covered by a five year warranty from date of shipment.

Mounting

The M-2025B Current Loop Interface Module may be mounted on any flat surface at least 4-5/8" wide and 2-5/8" high. Figure 3 depicts the hole drill dimensions for the M-2025B.
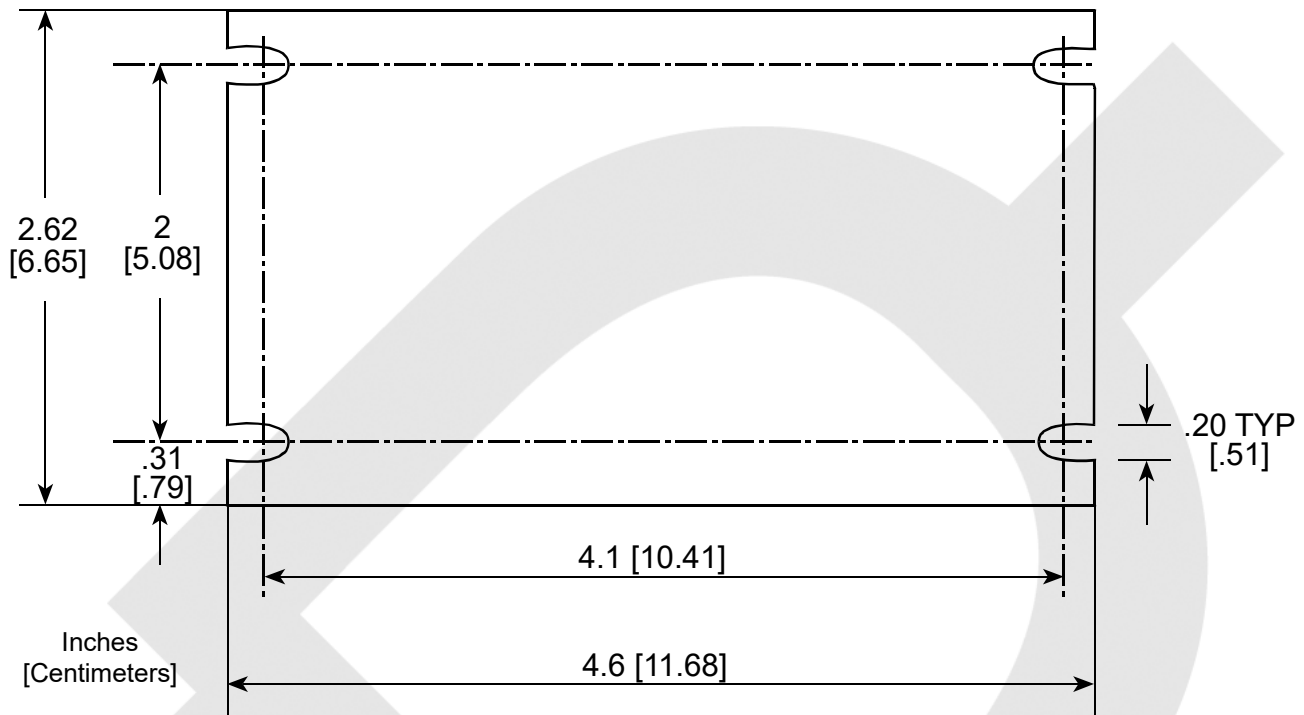

Figure 3   Hole Drill Dimensions

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