Line Drop Compensation For Substation Application

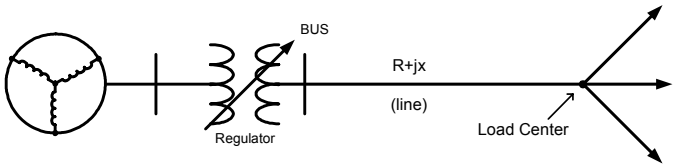
The M-2001B universal tapchnager control now includes two methods of LDC (line drop compensation). The traditional R&X method requires control inputs of line characteristics and the LDC-Z method requires knowledge of distribution system voltage drops.

#1 R&X Line Drop Compensation

Line Drop Compensation

LDC - R & X (Exact Compensation)

- Application: Load center remote from bus



- Concept: Regulate load center voltage
- Requires line impedance and ratios
- Uses complex phasor calculations
- Bus voltage increases as line drop increases

Purpose: To regulate the voltage at a point (load center) on a downstream line or feeder remote from the transformer or regulator bus.

Method: The control internally calculates the line voltage drop between the controlled bus and the load center using the input current (including angle) and the R & X values. The control automatically adjusts the bandcenter of the control to compensate the local voltage by the calculated voltage drop. (If the bandcenter setting is 120 V and LDC voltage drop calculation is 3 V, the new bandcenter will be 123 V. This causes the desired voltage level to appear at the load center.) (The setpoint may also be correctly lowered with leading power factor loads.)

Setting: R & X values are actually input as voltage values. These R & X voltage setting values are calculated as follows:

Rset = CT primary rating* x line resistance (ohms) / VT ratio

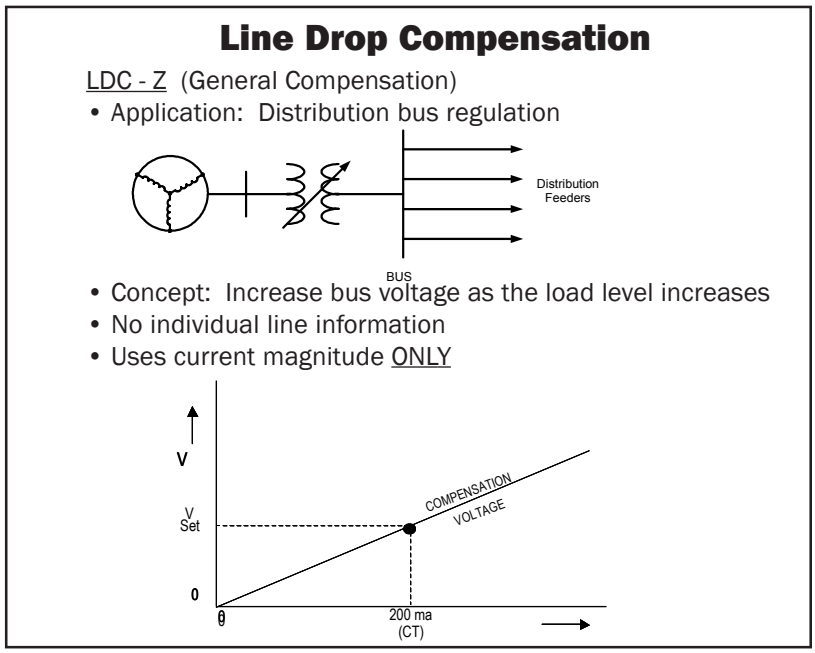
Xset = CT primary rating* x line reactance (ohms) / VT ratio

* Primary current resulting in rated current (200 ma) in the control.

Results: LDC R & X correctly calculates and compensates for described line voltage drop by adjusting local voltage, regardless of load level or load power factor. Accuracy is limited by the accuracy of the actual R & X calculations.

Caution: The R&X LDC method may develop inappropriate voltages if used in conjunction with substation or "close-in" capacitor banks.

#2 Line Drop Compensation (LDC-Z)



Purpose: To increase the distribution bus and system voltage as a function of total load through the regulating device. LDC-Z is applicable to transformer voltage control applications where no single line for LDC R & X line drop calculation exists. Problems with setting the traditional LDC R & X in this application result from:

a) No single line impedance is applicable to the single control
b) The total current from all feeders (transformer CT) are used for the line drop calculation
c) Load centers are different on each feeder
d) The relative magnitudes of current of different feeders are not constant

Method: LDC-Z simply allows the user to specify a desired bus voltage increase at a specified load current level. This defines a voltage increase per amp load current **slope** characteristic. The control will automatically vary the compensation amount from 0 volts at no load to the desired increase (setting) amount according at 200 ma of control load current.

Setting: The Vr setting **is** the voltage increase occurring at **full rated CT primary current***.
* Primary current resulting in rated current (200 ma) in the control.

System Example:

- The max load (I_M) on the circuit is 150 ma (control).
- The largest line voltage drop at maximum load (V_M) is measured or calculated to be 5 volts.

The setting calculation formula converts **a voltage increase amount (V_M) at less than rated current (200 ma)** to the increase at rated current (actual setting) for input to the control.

$Vr = (200 / I_M) \times V_M$ = (200 / 150) x (5) = 6.7 volts (setting)

To calculate the voltage drop compensation at any control current level (I), use the following formula:

V= (I / 200) x (Vr setting) If: I = 50ma & Vr = 6.7 - then V = (50 / 200) x 6.7 = 1.7volts

Note: The control will adjust the voltage for ANY current value, i.e. as with R&X LDC, first house protection is still required.

Results: When used in conjunction with the "block raise" and "deadband" settings also available in the M-2001B Tapchanger Control, the most effective distribution system load drop compensation can now be obtained.

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