



## Introduction to Hubbell Type 4019 Opotor Hoist Control:

The name Opotor is derived from "opposite torque" which describes the hoist controller system's operation that requires the presence of an overhauling load on the hoisting mechanism. Lowering speed of the Hoist is controlled by the repetitive application and removal of hoisting torque between two fixed levels. These levels are set by rotor resistance and adjusted by the opening and closing of any one of four contactors in the motor's rotor circuit (1A, 2A, 3A, & 4A). Four selections of motor torque allow a speed band spanning the range between an empty hook and a fully loaded hook, permitting only small changes in motor torque and producing smooth speed control.

## Operation of Hubbell's Type 4019 Opotor Hoist Control:

Hubbell's Type 4019 Hoist control system is a closed-loop, error-actuated system where a motor speed signal is derived from the motor's rotor voltage and causes a change in the motor's hoisting torque. The speed signal is applied to four voltage sensing relays, which in turn control contactors in the motor's rotor circuit, causing a change in the motor's hoisting torque. This allows the motor to have a nearly constant speed.

Four Hubbell Type 5300 duplex DC voltage relays are employed; these relays are designated VR1, VR2, VR3, and VR4. All four relays are set to pick-up progressively on rising voltage and to drop-out in reverse order on falling voltage. Rising voltage is produced in the lowering direction by the presence of a load capable of driving (overhauling) the mechanical inertia of the Hoist with the motor's stator connected in the raise direction and the motor's rotor initially open-circuited.

The minimum differential between pick-up and drop-out of any one relay is approximately 7% of the rotor voltage. The differential bands are set to overlap giving a speed regulation of approximately 12% from an empty hook to a fully loaded hook.

While progressively picking up the voltage relays and closing their related contactors, the restraining torque is increased until the lowering speed is checked and a mean speed will then be maintained by the cycling of the selected voltage relays and their respective contactors. It is the weight of the load and hence the restraining torque required to

check it's gravitational fall that determines which of the four voltage relay-contactor combinations will be employed.

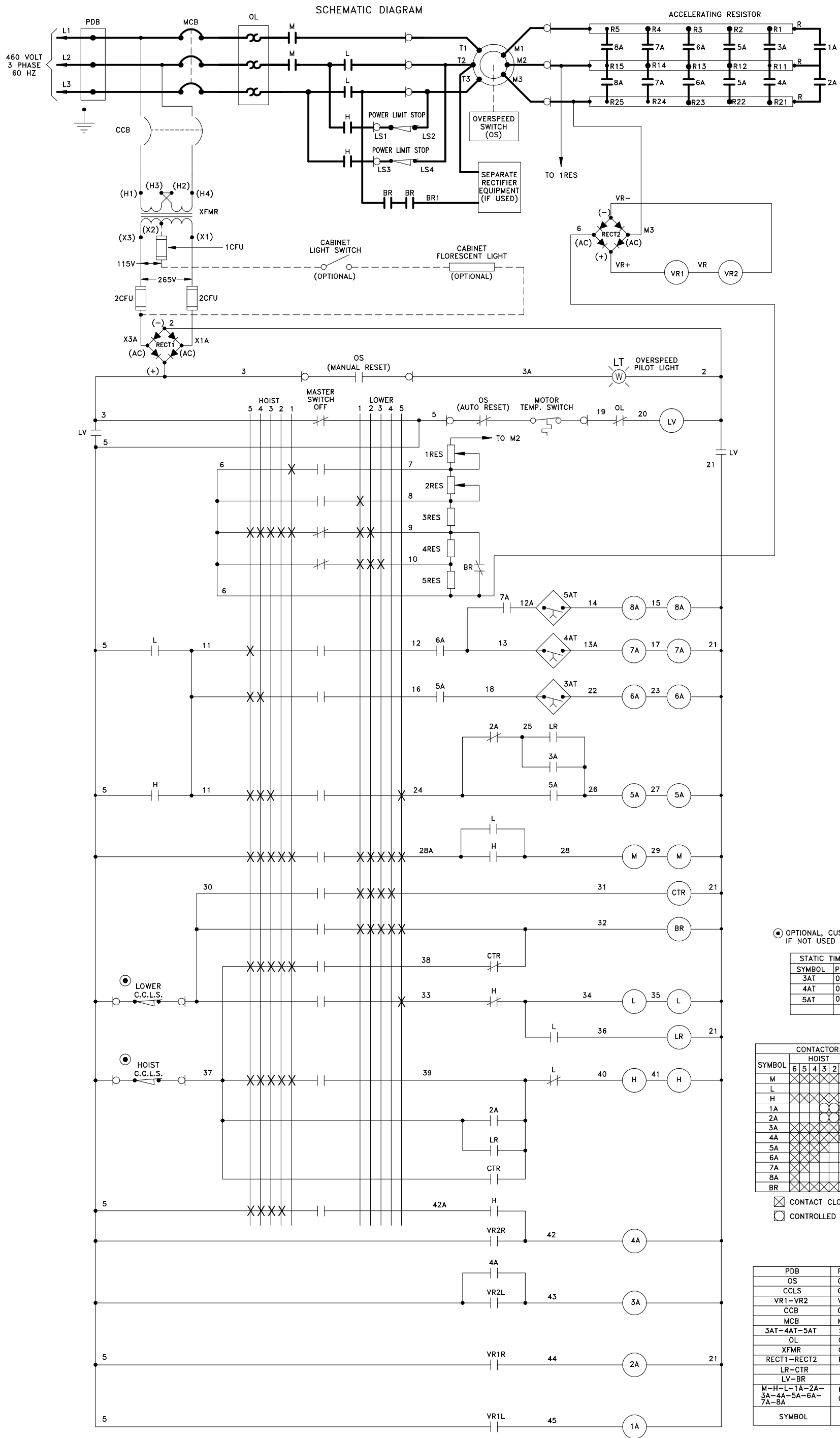
Although the Hubbell Type 4019 Opotor system is basically for the control of overhauling loads, slow speed hoisting is provided by the reverse action of this system. All four of the voltage relays pick-up initially allowing the motor to develop 90% torque. The voltage relays then drop-out progressively on rising speed reducing the level of hoisting torque until the speed is checked and a mean speed is maintained.

The voltage relays will always operate at the same value of ampere-turns and therefore, if series resistance is inserted or removed from the operating coil circuit, the rotor voltage at which the relays operate will have to adjust accordingly. This simple principle is used to achieve a range of preset speeds which for full load lowering are approximately 20%, 40%, 60%, and 80% of motor synchronous speed.

Four steps of Opotor are provided in the lowering direction, the fifth and final speed point being a drive down condition with the stator connected in the lowering sense and the motor in re-generation (hyper-synchronous speed). In the hoisting direction Opotor control is provided in the first step, with the motor developing sufficient torque to hold a fully loaded hook and with a controlled slow speed for less than capacity loads and taking up slack cable.

The speed difference between each of the lowering points is fixed by pre-set resistor sections in the voltage relay operating coils circuit and their relative displacement is non-adjustable. They can, however, be adjusted simultaneously as a body, and independently of the hoisting speeds, by an adjustable resistance section R11-R12. The second adjustable resistance section R-R11 adjusts all five speeds, i.e. hoisting and lowering simultaneously. If it is required to adjust the hoisting speed by adjusting resistance section R-R11 then it will be necessary to correct the lowering speeds by adjusting resistor section R11-R12. Reducing the resistance of section R-R11 will increase the hoisting speed and reduce the lowering speed. Increasing the resistance of section R11-R12 will only increase the lowering speeds. Whatever adjustment is made to resistance section R-R11, the opposite adjustment should be made to resistance section R11-R12.

# Type 4019 Opotor Hoist Control



⊙ OPTIONAL, CUSTOMER TO JUMPER  
IF NOT USED

STATIC TIMERS	
SYMBOL	PICK-UP
3AT	0.5 SEC
4AT	0.5 SEC
5AT	0.5 SEC

SYMBOL	CONTACTOR SEQUENCE											
	HOIST						OFF	LOWER				
	6	5	4	3	2	1		1	2	3	4	5
M												
L												
H												
1A												
2A												
3A												
4A												
5A												
6A												
7A												
8A												
RR												

☒ CONTACT CLOSED  
☐ CONTROLLED BY VR RELAY

PDB	POWER DISTRIBUTION BLOCK
OS	OVERSPEED SWITCH
CCLS	CONTROL CIRCUIT LIMIT SWITCH
VR1-VR2	VOLTAGE RELAYS
CCB	CONTROL CIRCUIT BREAKER
MCB	MAIN CIRCUIT BREAKER
3AT-4AT-5AT	STATIC TIMERS
OL	OVERLOAD RELAY
XFMR	CONTROL TRANSFORMER
RECT1-RECT2	RECTIFIER 25 AMP
LR-CTR	CONTROL RELAY
LV-BR	LOW VOLTAGE RELAY, BRAKE RELAY
M-H-L-1A-2A-3A-4A-5A-6A-7A-8A	MAINLINE, HOISTING & ACCELERATING CONTACTORS
SYMBOL	FUNCTION