



MELBOURNE AND METROPOLITAN TRAMWAYS BOARD.

SUPERVISORY EQUIPMENT

OPERATION MANUAL.

AUGUST 1963.

Issue No.

PART 1.GENERAL DESCRIPTION.1.1 INTRODUCTION.

This section of the manual provides a general description of the Supervisory Equipment and the facilities which it provides for the centralised control and indication of the operations of the major items of equipment in the Substations.

It has been assumed that the reader is already familiar with the operation of the various control devices in the Substations and discussion throughout the manual has thus been limited, as far as possible, to the Supervisory Equipment itself.

The equipment has capacity for the 26 existing Substations, one future Substation (Wx) and one Tie Station. Automatic Sectionalizing Switches are normally operated as satellites of adjacent Substations except for the four switches on C9 feeder which are grouped as a separate Substation with the cabinet located in the Royal Park Mess Room.

The Substations are divided into eight party line groups with up to four Substations per group. Each group may be operated as an independent supervisory system.

1.2 GROUPING OF SUBSTATIONS.

Group	Substation	Location
1	A Es Mg C9	Ascot Vale Essendon Maribyrnong Royal Park
2	B W Wx	Brunswick West Brunswick -
3	Co O T	Coburg Holden Street Brunswick Tie
4	C Cl S	Carlton Crombie Lane South Melbourne
5	Ch F N P	Clifton Hill Fitzroy Northcote Preston
6	H St Sy Y	Hawthorn St. Kilda South Yarra Young Street
7	G E M R	Glenhuntly Elsternwick Malvern Richmond
8	Cw D K Q	Camberwell Deepdene East Kew Kew

1.3 FACILITIES AVAILABLE.

The following facilities are available at the Control Room:-

- (a) Control of Leader, Trailer and "C" converting units via interposing relays (devices 203).
 - (b) Indication of position of Leader, Trailer and "C" unit devices 203.
 - (c) Indication of Unit Call via devices 1 X (for Leader) and 2 A X (for Trailer).
 - (d) Indication of position of A, B and C unit D.C. contactors (devices 73 etc.).
 - (e) Indication of unit preference, i.e. which unit, A or B, is Leader from the position of device 10.
 - (f) Control of D.C. feeder panels and auto section switches via interposing relays (devices 372).
 - (g) Indication of position of D.C. feeder panel and auto section switch devices 372.
 - (h) Indication of position of D.C. feeder panel and auto section switch breakers (devices 172).
 - (j) Telemetering of H.T. bus voltage by selection.
 - (k) Telemetering of summated load current continuously from all Substations.
 - (l) Indication of pilot line failure.
 - (m) Indication of Substation supervisory battery low voltage.
 - (n) Indication of control station supervisory battery low voltage.
 - (o) Indication of condition of Substation ventilating fans.
 - (p) Indication of position of Substation electrolysis drain contactors when fitted.
 - (q) Indication of supervisory isolation of converting units, feeder panels and auto section switches.
 - (r) Indication of Substation supervisory fuse failure.
 - (s) Indication of control station supervisory fuse failure.
 - (t) Telephone communications between each Substation and the Control Room.
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1.4 PILOT LINE NETWORK.

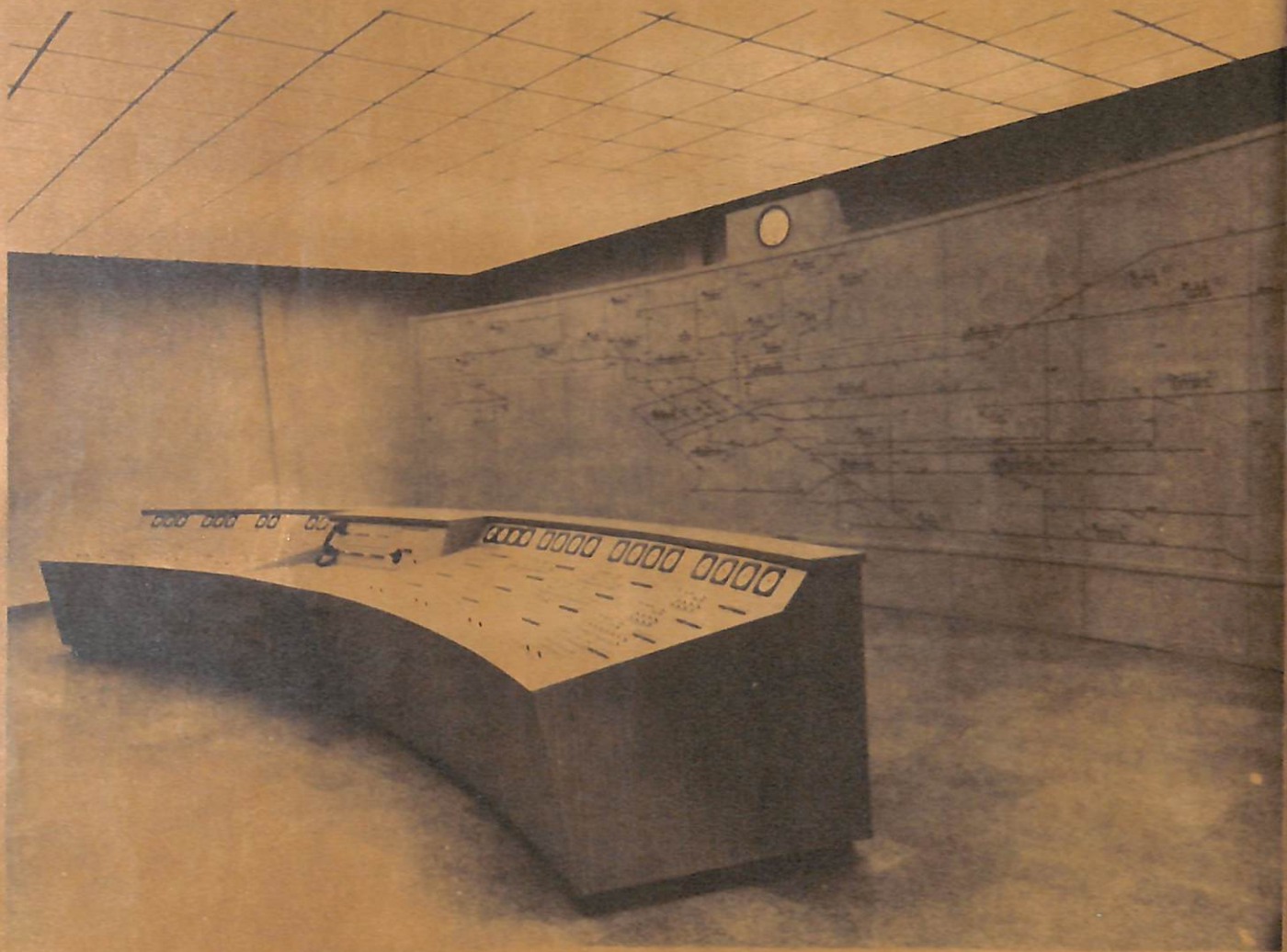
Each group of Substations is connected with the Control Room by two pairs of pilot cables as party line circuits. An additional pair is connected between each Substation and the Control Room.

The first pair of party line circuits is used for control, indication and telephone communications.

The second pair of party line circuits is used for the metering of H.T. voltage by selection.

The pair connected to each Substation is used for the continuous metering of summated load current.

Thus, a four Substation group will have a total of six pairs of pilot cables.



1.5 CONTROL ROOM EQUIPMENT.

1.51 Wall Diagram.

The trolley wire system is depicted in an elongated geographic layout.

Each major item of equipment is indicated on the diagram by a light which will flicker, flash or change colour as the condition of that item of equipment changes.

A large white light at each Substation designation will indicate that at least one item of the supervisory equipment (except ventilating fans and electrolysis drains) connected with that Substation is isolated. The particular item will be indicated by a white light.

The voltmeter mounted above the diagram may be connected to read the H.T. supply voltage at each Substation by selection.

1.5 CONTROL ROOM EQUIPMENT.

1.52 Central Desk Panel.

The Central Desk Panel of the Main Control Desk contains the telephone switchboard which provides direct communication between the Substation and the Supervisor on duty.

A display panel adjacent to the telephone switchboard provides visual indication of the Substation Group in which an operation occurs, the existence of a line fault and various control station equipment failure alarms.

The Alarm buzzer - which sounds when a change in condition of any item of Substation equipment occurs - is cancelled by means of a key on the desk. This key may also be used to switch off the buzzer if necessary. When this occurs a red lamp above the key is illuminated.

A large switch on the Central Desk Panel is provided for the changeover of supply to the Wall Diagram from A.C. to D.C. in the event of a local supply failure. The lamps on the Diagram are normally supplied from an A.C. source and the switch must remain in this position whenever possible to reduce battery drain.

1.5 CONTROL ROOM EQUIPMENT.

1.53 Control Desk Panels.

Eight Control Panels are provided (one for each Substation group) situated four on each side of the central desk. Each panel carries the equipment to initiate and acknowledge changes of position of Substation equipment and meters to indicate the summated load at each Substation.

1.6 SUBSTATION EQUIPMENT.

Each Substation equipment cubicle, including C9 at the Royal Park Mess Room contains the equipment to -

- (a) Convert the control signals from the Control Room to impulses which operate the devices (203 or 372) selected.
- (b) Transmit appropriate impulses to the Control Room when a change of the position of the monitored devices (including low battery voltage and supervisory fuse fault) takes place.
- (c) Transmit to the Control Room the indication of H.T. voltage as selected and of H.T. current continuously (except C9 and T).
- (d) Operate a direct telephone with the Control Room.

The necessary batteries, battery charger and pilot line protection equipment are also provided.

1.7 PRINCIPLES OF OPERATION.

As mentioned earlier, the Substations are divided into eight groups and each Substation in a group is connected to a party line circuit. The transmission of Control Codes from the Control Room to the various Substations, and of Indication Codes in the opposite direction, is effected over the party line by the method of signalling known as Phase Modulation.

With Phase Modulation the speed of signalling is at the rate of ten impulses per second, so that each complete signal pulse occupies a period of one hundred milliseconds. Each controlled device in the group of Substations is allotted an individual Control Code made up of a series of positive and negative pulses arranged in a certain order. Similarly, each indicated device in the group of Substations is allotted an individual Indication Code.

When the Supervisor in the Control Room prepares to send a Control Code to operate a device in a Substation he must first set up the relay equipment in the basement of the Control Room by turning the Control knob for the device into the desired position and then depressing the Select button. This action prepares the equipment for the transmission of the necessary Control Code and sets up a flickering light in the Control knob and on the Wall Diagram to indicate that the device has been selected. However, no signal is transmitted to the Substation until the Send Signal button is depressed.

When this action is performed the Control Code is transmitted over the party line and is examined by the Supervisory Equipment in each Substation of the group to determine whether it is an instruction to change the position of a device at that Substation. At one Substation the Code will be accepted and connections will be made so that an interposing relay receives an impulse to change the position of the device.

When the device changes position, the change is registered in the Substation Supervisory Equipment and a Code reporting the positions of a group of 12 devices in the Substation is then transmitted back to the Control Room where it is decoded. The equipment determines which Substation initiated the signal and the reported positions of the devices are then compared with the positions stored in the memory of the Control Room equipment. The position of the operated device will differ from the stored position and a discrepancy lamp will flash in the appropriate Semaphore knob. When the knob is turned into agreement the stored position will be changed to the new position and the discrepancy lamp will cease to flash.

An automatic operation of a Substation device will

(see over)

also initiate an Indication Code which reports the actual position of 12 devices.

The Indication Codes for each group of 12 devices contain an element which indicates the position of each device. The element of the Code referring to a particular device may be any one of four combinations of positive and negative impulses -

- + Closed
- + Open
- - + Isolated
- - - Dirty or disconnected auxiliary contacts.

The Closed, Open or Isolated position of the device may be acknowledged by turning the semaphore knob into agreement as mentioned previously. If the dirty or disconnected signal is transmitted from the Substation, the discrepancy lamp in the semaphore knob for that item will continue to flash no matter to what position the semaphore knob is turned. In addition, the appropriate Wall Diagram lamp will flash Red.

The first step on receipt of an Indication of this type is to arrange for inspection of the auxiliary contacts and of the plug for the device.