इ रि से ट
विद्युत सिगनल प्रयोगशाला
प्रयोग नं: ई एस एल -1

IRISET
ELECTRICAL SIGNALLING LABORATORY
EXPERIMENT NO.: ESL - 1

नाम
Name : _____

अनुक्रमांक
Roll No : _____

पाठ्यक्रम
Course : _____

दिनांक
Date : _____

प्राप्त अंक
Marks Awarded :

अनुदेशक का अधाक्षर
Instructor Initial :

Q- SERIES PLUG IN TYPE D.C. RELAYS (NON PROVED Type)

Plug in type relays are preferred in place of shelf type relays now a days to for the following reasons:-

1. They are compact and they occupy less space.
2. They carry more contacts due to their light structure.
3. They are quick to operate.
4. They have longer life i.e., 10^6 operations as against 10^5 of shelf type relays; and
5. These can be replaced without disturbing the wiring.

'Q' series relays made to BRS specifications and similar makes of vital relays are to be studies here. Vital relays are those whose malfunctioning affects safety in train working.

These relays are plugged into pre wired terminal boards and they can be replaced very quickly. A coding pin arrangement is provided to match the relay contact combination with that of plug board wiring. This is to ensure that a front contact of the relay shall not get connected to a back contact wiring on the board and vice versa. If allowed, this can cause unsafe conditions. Various contact combinations for each type of relay are so grouped, as to satisfy this conditions and allotted separate codes.

As the relay armature is fixed in front and not below the core, a pusher spring is provided to restore it to its full release position when the coil feed is cut off or reduced. The pusher spring also gives sufficient pressure to the relay back contacts.

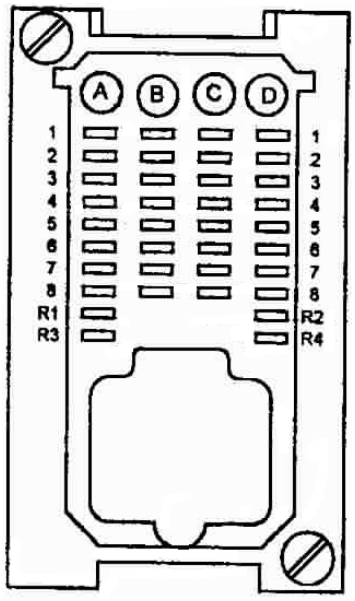
Clip type wire connectors when pushed in get locked in their respective slots of the terminal board. For their removal, they shall be lifted up and unlocked in their slots by a sharp tool from the relay side of the board so as to be drawn out.

24V D.C. 'Q' series line relays are generally used on railways. They have 8 to 16 independent 'Metal' to 'Carbon ' contacts. QJ1 type thermal time element relays, however, have a 'metal' to 'metal' dependent heat actuated contact in addition to two front and one back 'Metal' to 'Carbon' contacts.

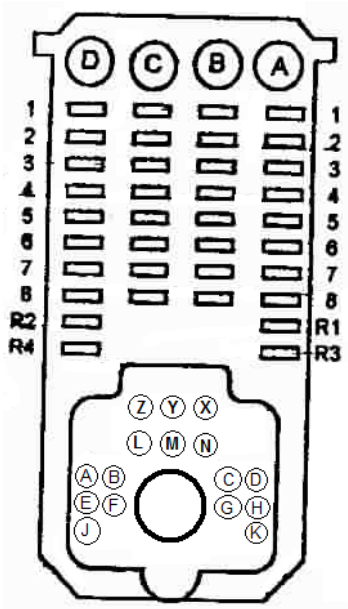
In addition to Non A.C. immunised and immunised D.C. neutral line relays (QN1 & QNA1) of common type, various special types of relays such as: (1) Latch relays (QL1) (ii) Biased Line Relays (QB3, QBA1) (iii) Biased Point Contactors (QBCA1) (iv) Sensitive Neutral Line Relays (QS3) (v) Twin Neutral Line Relays (QNN1) (vi) Slow to Pick up Line Relays (QSPA1) (vii) Slow to Release Line Relays (QSRQ1) (viii) Time

Element Relays (QJ1) (iv) Lamp Proving Relays (QECX1, QUCX1) and some such other types are available among these. These relays have their own designated coding pin positions so that they cannot be accommodated in each other's places.

GENERAL FEATURES: PLUG BOARD



BACK VIEW OF PLUG BOARD



FRONT VIEW OF PLUG BOARD

Choosing from 16 positions shown above, 5 holes are provided on the plug board to accommodate coding pins available at the back side of the relay. This coding prevents plugging of wrong relays in the base. For each type of relay, a common code is allotted for a group of relays with common contact positions.	A1. B1. C1. D1 FIXED POSITIONS A2. B2. C2. D2 FOR A3. B3. C3. D3 FRONT CONTACTS A4. B4. C4. D4 A5. A6. A7. A8 FIXED POSITIONS D5. D6. D7. D8 FOR BACK CONTACTS B5. B6 . B7. B8 POSITIONS FOR C5. C6. C7. C8 EITHER FRONT OR BACK CONTACTS.

WIRE CONNECTOR

Only two wires can be connected to each Contact. They can either be crimped or soldered.

Recommended Wire:-

1. For all sigg. Circuits Carrying Normal currents. 16/0.2 mm dia. Multi-strand flexible copper wire.
2. For point motor feed through 9/0.012" Multi-strand copper wire.

Maximum permitted contact Resistance : M to C Contacts = **0.20 Ω**

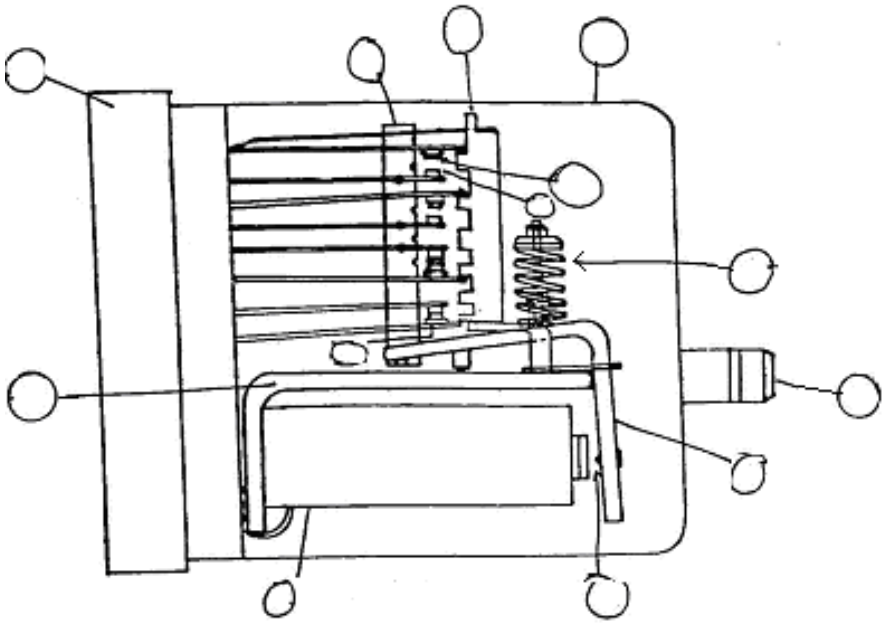
(To be measured when relay is energised by 125% of its P.U. current)

Current Carrying capacity of Relay contacts:

The continuous current rating of each contact is 3A. The switching current rating depends on the nature of load through the contact, viz., inductive or non-inductive load. (coil offering inductance is called inductive load)

1. D.C. NEUTRAL LINE RELAYS (Non - A.C. Immunised) QN1 RELAY
Specification: BRS 930/930 A.

Contact combinations available are 12F.4B: 8F.4B: 8F.8B. 6F.6B & 4F.4B.



Identify the following parts in the sketch:

1) Relay base	2) Electro-magnet	3) Armature
4) Pusher spring	5) Fixed front contacts	6) movable arm contact
7) Fixed back contact	8) Operating arm	9) Adjustment card
10) Residual pin	11) Transparent cover	12) handle
13) Heel piece		

2. Study of QNA1 Relay: Specification: BRS 931/932 A

A copper slug is provided around the core near the armature end as shown in figure below. But for this, the design of the relay is similar to that of QN1 relay: QNA1 relays are used for external circuits in the AC RE sections. In the faulty condition the induced AC voltage will appear across the relay coil. This produces an alternative flux which in turn induces an eddy current in the copper slug. This induced current in the copper slug will produce a flux which will oppose the alternating flux produced by the induced voltage thereby preventing it from passing through the air gap. Thus, the relay is immunised up to 300 V AC R.M.S. at 50 Hz.

3. Study of QL1 (magnetic Latch) Relay: Specification: BRS 935 A

This is a two position polarised magnetic stick relay. It is provided with two windings such as Normal (680 ohm) and Reverse (145 ohm) windings. A permanent magnet is provided adjacent to the core as shown in Fig. below. When the 'R' coil is energised, the flux produced by the coil assist the permanent magnet flux and the armature is attracted to Reverse position. The armature is held in this position even after the power supply to the coil is removed. When supply to the 'N' coil is given through its own contact, the flux produced by this coil opposes, the permanent flux and neutralises it. Hence the armature is pushed to the normal position by the pusher spring.

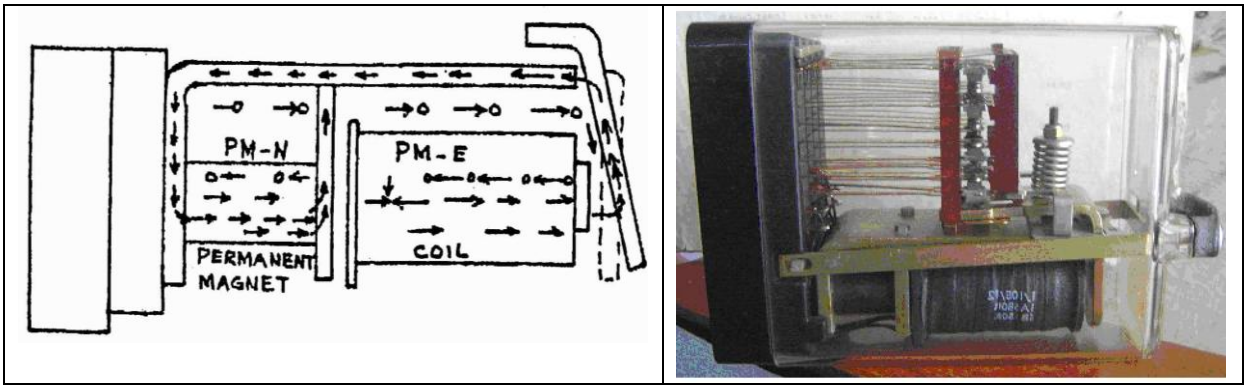
(a) Study the construction of the relay. There are four different 'arrows' shown in the figure below. Match the arrows with the statement given below:

i) Permanent Magnet flux with relay in 'N' condition shown as:

ii) Reverse coil flux shown as:

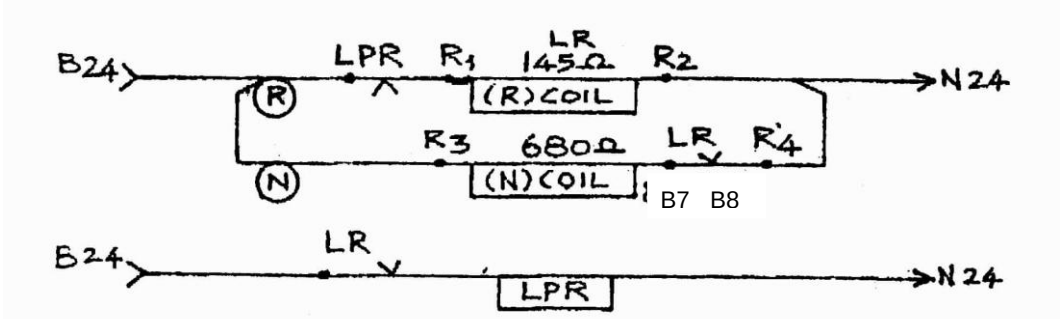
iii) P.M. Flux extended through armature when magnetically latched shown as:

iv) Normal coil flux shown as:



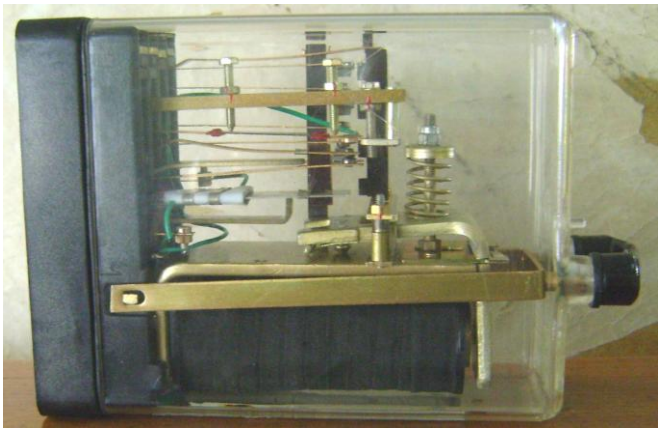
QL1 Relay

(b) Study the working of the relay from the circuit diagram given below:



The feed to the latched relays are always disconnected as soon as they are latched. This is achieved here by _____back contact for 'R' coil, and by _____front contact for 'N' coil. Prolonged feed to 'N' coil is disconnected by introducing _____ front contact, which protects the demagnetisation of _____magnet inside the relay.

4. Study of QJ1 Relay. THERMAL TIMER RELAY: made to BR Spec. No.937



This is a thermal time element relay. It has a heating element (H) and a neutral relay (R) which together energizes an external line relay after a pre-set time delay. The thermal element consists of a bimetallic strip having ' invar' (iron) at the top and brass at the bottom. A heating coil (TH) is wound over it. For a given heat, 'invar' expands less and 'brass' more. Since their ends are sealed together, the free end of the strip moves above gradually as being heated. This pushes up an arm contact to close with a 'hot contact' spring after a pre-determined time. Closing of hot contact energizes the 'JSR' relay coil, which sticks through its own front contact across the hot contact. When the 'JSR' is energized, its back contact in the thermal coil circuits opens. After some time, the heating element cools off and its arm closes with the cold contact. This cold contact in series with a 'JSR' front contact extends feed to an external relay. The complete cycle of making a hot contact and then a cold contact ensures that the thermal contacts are normalized before each operation. This in turn results in the time delay being equal for all operations. In this relay, the time lapse during the 'cool off' of the heat element is thrice the time lapse during its heating.

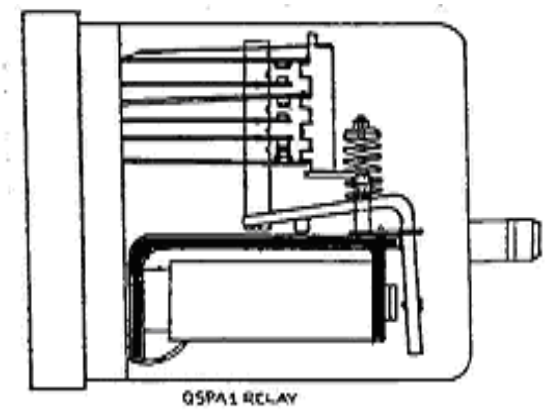
5. Study of QBCA1 Relay: Specification: BRS 943

QBCA1 is an AC immunised Biased contactor relay. The copper slug provided at the core face provides the AC immunity to the relay. The Horse shoe magnets mounted at the core face do provide the biasing on the relay. Biasing also can be achieved by providing diodes externally. The diagram explains how the biasing is achieved. The advantage of biasing is such that two conflicting relays can be made to operate on a pair of conductors. Giving the advantage of saving no. of conductors in point control circuits. This relay is biased to 20 times of its operating DC voltage.

The Heavy Duty (HD) contacts are rugged to switch and carry a current up to 30 Amps. Spark quenching of HD contacts are achieved by providing two ceramic magnets in an arc chamber. The ionised air deviate the flame and arcing intensity is reduced while switching ON/OFF the load.

A magnetic shunt is provided on the core face to protect the permanent magnet from decaying the magnetism, which provide as a cover to the permanent magnet.

6. QSPA1: Q series Slow to pick up AC immunized DC neutral relay. Spec. BRS 933A



Pick up time:	: 540-600 m seconds.
Release time	: 140-200 m seconds.
Working voltage	: 24 VDC
Coil resistance	: 208 ohms
Contact configuration	: 8F / 4B
A/C Immunity level	: 300 V AC

Magnetic shunt is provided at the armature end to make the relay slow to pick up. Magnetic shunt is of a magnetic material, when the current flows through the coil it set up a flux which passes through the magnetic shunt after a time delay the magnetic shunt saturates, further fluxes will not flow through the magnetic shunt. The magnetic circuit completes through core, air gap, armature and heel piece their by armature get attracted.

To make the relay AC Immunized Copper slug is provided at the heel piece end.

Used as TPR where Q-series AC immunized track relays are provided. OHE Circuit Breaker tripping may take around 300 m seconds after catenary's snapping/short circuiting of OHE supply. This causes high voltage drop across the track, which may operate the Track relay. But it is essential that the repeater should not pick up. Hence slow to pickup repeater relay is used. Pick up time for relays used as repeating relays with plug in type AC immunized track relays shall have a pick up time of at least 400 m seconds.

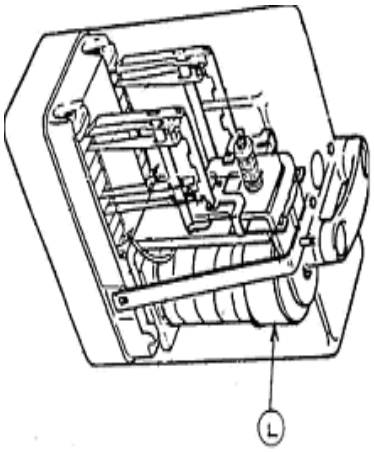
This increase the Pickup time: 540-600 m seconds.

7. D.C. Track Relays with carbon to metal contacts: QT2 Specification: BRS 938A

[QT2 Style Track Relay made to Relay Spec. 26/6:-This accord with. B.S. Spec. 938 A only to an extent].

The construction of this relay is similar to that of a Q-Series line relay except that its contact load is reduced drastically. Also, the relay is made more sensitive and workable on a low voltage. It has one or two back contacts, in a deviation from B.R. Spec for QT2 relay, facilitating cross protection in remotely located TPR circuits. This has a single coil of 4 ohm or 9 ohm resistance unlike the shelf type relay which has two coils with open ends.4 ohms relay is used for longer length track circuits and 9 ohm relay for shorter length track circuits. 2F/1B to reduce load on armature. Hence sensitive and can operate at low voltages. Back contact is used for cross protection to prevent the repeater relay from picking up in case of false feed.

8. QTA2: AC immunized DC neutral track relay. Spec: BRS 939A.



A/C Immunity level 50V AC rms.

Contacts 2F/1B.

9 ohm relay is standard and 20 ohm relays are also available.

Being sensitive relay its DC PU value should not change by a larger extent hence the limitation on the AC immunity. Same as in shelf type.

Max length of Track circuit is 450mtrs. (Rail voltage drop is 10V /90mtrs of track circuit).

QSPA1 only to be used as repeater relay with QTA2.

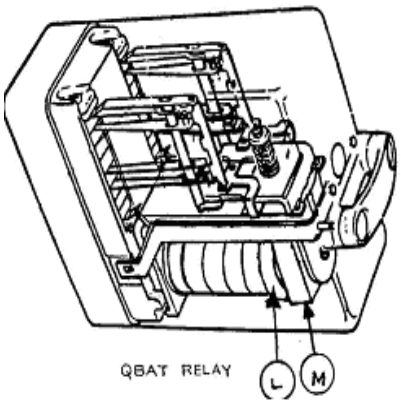
20 ohm relay: PU volts: 1.4 to 2.0V, PU current: 80mA to 90mA.

9 ohm relay: PU volts: 1.0 to 1.4V, PU current: 120mA to 140 mA.

QTA2 RELAY

9. QBAT: Biased AC immunized Track Relay (Made to RDSO Spec. 84/88):

This also accords with B.R. Spec. 939 A and 966F to an extent. This is a track relay with an improved immunity level of 80V A.C. by the provision of a biasing permanent magnet on its core along with its copper slug. This biasing by initially polarizing the core strengthens its electro-magnetic flux created in the correct direction by coil current. This takes more AC voltage to disturb the DC working flux. This relay also requires QSPA1 relay as its 1st TPR for the same reasons specified in the case of QTA2 relay.



Contact configuration	: 2F/2B.
PU volts	: 1.1 to 1.75V, PU current: 140mA to 175 mA.
ACI	: 80V,
Coil resistance	: 9 ohms.
Max length of track circuit	: 720mtrs and can be extended to 750mtrs by using a choke at relay end.
Maximum excitation	: 235% only because of the flux of P.M.

Non-RE area:

Type of TC	Type of Track Relay	Track Relay Resistance (L= Length of the Track Circuit)	Cells at Feed end	PU Voltage Approx	PU Current Approx
DC TC for Non-RE	Non ACI Plug in Type (**QT2**)	For L < 100 m→ 9 Ω	1 cells (2 V)	1.5 V	150 mA
		For L > 100 m → 4 Ω	2 cells (4 V)	0.5 V	125 mA

Sl. No	Sleeper	Section Yard/ Block	Min. R_B in Ω / Km	TSR in Ω	Max. Length of Track Circuit in meters	Type of Track Relay to be used
1	Wooden /PSC	Block	4	0.5 Ω	1000 m	QT2
2	Wooden /PSC	Yard	2	0.5 Ω	670 m	QT2

RE area:

Type of TC	Type of Track Relay	Track Relay Resistance	Cells at Feed end	PU Voltage Approx	PU Current Approx
DC Single Rail Track circuit – AC RE Area	ACI Plug in Type QTA2	9 Ω	2 cells up to < 100m 3 cells > 100 m	1.4 V	140 mA
	ACI Plug in Type QBAT	9 Ω	2 cells up to < 100m 3 cells > 100 m to 450m 4 cells up to 750m	1.75 V	175 mA

Note: For operation of track circuits up to 750 m length with this type of relay, four secondary cells delivering 8.8V is required. (Ref. R.B. Lr No.87/W3/SG/T/1 dated 26.11.92.)

Sl. No	Sleeper	Section Yard/ Block	Min. R_B in Ω / Km	TSR in Ω	Max. Length of Track Circuit in meters	Type of Track Relay to be used (L= Length of the Track circuit)
1	Wooden/ PSC	Block	4	0.5 Ω	450 m	QTA2 (ACI level = 50V AC)
2	Wooden	Yard	2	0.5 Ω	450 m	QTA2 (ACI level = 50V AC)
3	PSC	Yard	2	0.5 Ω	350 m	QTA2 (ACI level = 50V AC)
4	PSC	Yard	2	0.5 Ω	750 m	QBAT (ACI level = 80V AC) in conjunction with QSPA1 With B-type Choke at relay end.

DATA SHEET FOR "Q" SERIES NEUTRAL LINE RELAYS

S. No.	Relay Style	Description	B.R.S. Spec. No.	Relay Spec. No.	Contact Arrangements.	Code No.	Code Pin Positions	Coil Res. (Ohms)	Wkg. Volt. (Volts) D.C.	Max. PUV (volts)	Min. PUV (volts)	Min. DAV (volts)	A.C. Immunity (volts)	P.U. Time (m. sec)	D.A. Time (m. sec)	Contact Rating (Amps) Continuous	Current (Amps) Switching	Usage & Other Remarks.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.
1	QN1	D.C.Neutral Line Relay	930A	01/16 01/18	12F.4B 8F.4B	001	ABC DE	340 to 470	24	19.2	-	3.6	300	150	20	3	2	All ccts.of Non-RE & Internal ccts. of RE. In emergency external ccts. of RE area.
2	"	"	"	01/17 01/19 01/20	8F.8B 6F.6B 4F.4B	002	ABC DF	"	"	"	-	"	"	"	"	"	"	—"—
3	"	"	"	01/21 01/23	12F.4B 8F.4B	003	ABC EF	1000/ 1500	50	40.0	-	7.5	-	"	"	"	"	Used as Track Relays with AFTC
4	"	"	"	01/22 01/24 01/25	8F.8B 6F.6B 4F.4B	004	ABD EF	"	50	"	-	"	-	"	"	"	"	—"—
5	QS3	" (Sensitive)	"		4F.4B		CDEK X	1000	12	9.35	7.5	3.75	-	-	-	"	"	In place of shelf type relays:Ex: EVR & SUPR of AXC's
6	QNN1	" (2-relay unit)	960	19/1	6F.2B	092	ACD EK	470	24	19.2	-	3.6	-	-	-	"	"	All ccts.of non-RE & Internal ccts of RE Area.
7	"	"		19/2 19/3	4F.4B 2F.2B	057	ACE HJ	"	24	19.2	-	3.6	-	-	-	"	"	
8	QB3	D.C.Biassed Line Relay (M/I)	-	PTJ/ QB3	4F.2B	-	ABF GX	200	12	9.6 @ (45 mA)	8.0	-	-	380	20	"	"	CRS of PTJ make T/less Block Instt.
9	QNA1	A.C.Immune DC/NL Relay.	931A	05/11 05/13	12F.4B 8F.4B	021	ABD FH	208	24	19.2	-	3.6	300	220	70	"	"	External circuits of R.E.Area.
10	"	"	"	05/12 05/14 05/15	8F.8B 6F.6B 4F.4B	022	ABD GH	208	24	"	-	"	"	"	"	"	"	-do-
11	QBA1	D.C.Biassed ACI N/L Relay	932A		12F.4B 8F.4B			"	24	"	-	"	"			"	"	
12	"	-do-	"		8F.8B			"	"	"	-	"	"					

DATA SHEET FOR "Q" SERIES NEUTRAL LINE RELAYS (continued)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
13	QBCA1	DC biassed ACI contactor Relay.	943		2F(HD). 4B	170	BCE JK	208	24	19.2	-	3.6	300			30A-F 3A-B	30A-F 2A-B	Point Machine Control in R.E.area.
14	QSPA1	Slow Pick Up ACI N/L Relay	933A	11/1	8F.4B	041	ABDEJ	"	"	"	-	"	"	540/600	140/200	3A	2A	For TPRs with QTA1& QBAT Track Relays
15	QSRA1	Slow Release ACI N/L Relay	934A	08/13	8F.4B	061	ADEFJ	"	"	"	-	"	"	-	260 @ 19.2 V	"	"	For use in Ac RE area.
16	QL1	DC Magnetic latch relay	935	09/05	8F.6B	007	ABCEG	R-150 N-680	"	"	9.6V	-	-	-	-	"	"	TCPR and TGTR of
17	"	-do-	"	09/03	11F.4B	009	ABDEG	"	"	"	"	-	-	-	-	"	"	PTJ make T/less Block.
18	QJ1	DC Neutral Time Element Relay.	937		1F		APGH K	H-40 JS-400	"	-	-	-	-	30/60/90/ 120 Sec	-	"	"	

DATA SHEET FOR Q - SERIES LAMP PROVING RELAYS

S.No.	Relay Style	IRS Spec. No.	Relay Type Number	Contact Arrangement	Pin Code No.	Code Pin Positions	Coil Res. (Ohms)	Rated Current	Voltage drop @ 250 mA Current	Max. Full Operate Current	Max. Release current	Min. Release Current	Typical Interruption Time	Usage With
1	QECX1 (off/on)	941 A	13/1 (WSF)	4F	071	ABCDK	35	400 mA	9 ± 0.6 V A.C.	180 mA	-	110 mA	100 ms @ 180 mA 200 ms @ 250 mA	SL 35 Lamp
2	QECX12 (off)	"	13/11 (WSF)	4F	-	-	4.7	"	-	120 mA	-	60 mA	100 ms @ 110 mA	SL 17/SL 21 (DECR)
3	QECX13 (on)	"	13/12 (WSF)	4F	-	CFKMX	"	"	-	225 mA	-	120 mA	100 ms @ 220 mA	SL 17/SL 21 (RECR)
4	QECX14 (off)	"	13/13 (WSF)	4F.4B	-	CFJKM	"	650 mA	-	220 mA	-	70 mA	"	SL 17/SL 21 (DECR)
5	QUCX1	942 A	13/9 (WSF & Crompton)	2F.2B	-	CFKLX	0.76	1400mA	3.3 VA.C	780 mA	590 mA	520 mA	-	SL 33 Direction Type R/I (4F.4B)
6	QECX-51	941A	Crompton make	4F.4B	-	-	-	400 mA	9 V A.C.	180 m	-	110 mA	-	SL 17/SL 21 (RECR)
7	QECX-52	"	"	4F.4B	-	-	-	"	"	75 mA	-	35 mA	-	SL 17/SL 21 (DECR)

LINE RELAYS

Sl. No	Type of Relay	Relay Sl. No	Code no.	Contact Arrange-ment	Code pin Positions	Coil Resist. Ω	Nominal PU Voltage	Pick up voltage	Pick up Current	Drop Away Voltage volts	Drop Away Current mA	% of Release = DA value / PU value X100
1.	QN1											
2.	QNA1											
3.	QSPA1											
4.	QBCA1											

Note: Minimum percentage release shall be 50% for class 'B' Line relays & 60% for class 'A' Line relays and 68% for Track Relays.

TRACK RELAYS

Sl. No	Type of Relay	Code No.	Contact Arrange-ment	Code pin positions	Coil Resistance	Nominal PU Value	Pick up Voltage	Pick up Current	Drop away Voltage	Drop away Current	% of Release = DA value / PU value X100
1	QT2										
2	QTA2										
3	QBAT										

Date:

Signature of the trainee