

Chapter - 3

Contract Drawings for Power Transformers

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CHAPTER - 3

CONTRACT DRAWINGS FOR POWER TRANSFORMERS

1. INTRODUCTION

This part of Manual lists the typical drawings submitted by manufacturer to the customer for approval and reference. The purpose of these drawings is to ensure that transformers being planned for manufacture meet the guaranteed technical particulars as per order, functional requirements as per customer specifications and interfaces at site. The Manual lists up the minimum details required in drawings and can be used as a check list for manufacturers, customers and consultants while preparing, verifying and approving these contract drawings.

2. LIST OF CONTRACT DRAWINGS

Drawings list should have the revision status and date of submission / approval.

1. Rating & Diagram Plate
2. General Arrangement drawing for Transformer
3. List of Accessories
4. Bill of Materials
5. Foundation Plan
6. Bushing Details
7. Transport Dimensions
8. General Arrangement Drawing of Marshalling Box/ Cooler Control Cubicle
9. General Arrangement Drawing of RTCC panel
10. General Arrangement Drawing of Junction box (if applicable)
11. Tap Changer Control Scheme
12. Cooler Control Scheme
13. Alarm / Trip Indication Scheme
14. Interconnection between DM and RTCC
15. General Arrangement Drawing for Cable Box (If applicable)
16. General Arrangement Drawing for bus duct termination (if applicable)
17. Valve Schedule Plate

3. GENERAL GUIDELINES

- a. All drawings shall be "to scale"
- b. Drawings can be either in first angle or third angle projection. Angle of projection shall be mentioned in drawing. Preferred projection is First Angle Projection.
- c. Title block shall contain customer reference (Customer name, PO/LOI number), Transformer MVA rating and voltage.
- d. All drawings may be either in A3 or A4 size for easier up-keeping.
- e. Drawings shall also be submitted in soft form.

4. MINIMUM DETAILS REQUIRED IN DRAWINGS

4.1 Rating & Diagram Plate

- Rating & Diagram Plate drawing shall be in line with the guide lines in CBIP Transformer Manual.
- Plate can be made in one part or two. In case of two plates, cross reference shall be given in both sheets.
- Keep blank columns to fill after testing for % Impedance, measured losses, weight schedule and oil volume for first filling at site. Weight schedule shall contain (a) Core - coil assembly weight (b) Tank & fittings weight (c) Oil weight (d) Total Weight, (e) Transport weight (f) Net copper weight (g) Net silicon steel weight (h) Net mild steel weight (i) Type, grade and standard of oil
- Transport weight can be either oil filled or gas filled (Dry Air or Nitrogen) depending on transport limitations & road route survey. Hence, it shall be indicated as Transport Weight (with oil / without oil)
- Material of rating plate shall be stainless steel of minimum 1.0 mm thickness.
- Location and terminal markings of BCTs.
- Diagram plate shall indicate actual physical connections of windings (e.g. line entry of HV, with two halves in parallel, set of parallel / series windings in two limbs of core etc.)
- Provision of special accessories connected to windings, zinc oxide elements across regulating winding, tie-in-resistor in tap changer, external neutral grounding resistors etc.
- In case air cell is provided in conservator, add a note "Conservator is fitted with an air cell".
- CT details like ratio, accuracy class, burden, Knee point etc.
- Rating Plate Drawing shall be in English language. In second language on request.

4.2 General Arrangement Drawing

- All accessories & fittings can be numbered with standard logic in line with DIN 42513 so that same number can be used for identical items. (Annexure 3.1).
- Approximate Weight & Oil quantity schedule (Weight of core-coil assembly, tank & fittings, weight & volume of oil for first filling, total weight of completely assembled transformer and transport weight (gas or oil filled) as per final design.
- Minimum electrical clearances (Phase – Phase & Phase – Earth) as per CBIP guidelines / customer specifications.
- Minimum four views (Plan, Elevation, Right hand side & Left hand side view looking from HV side). 3D views can also be given for additional clarity.
- View showing maximum lifting weight / height of core – coil assembly or upper tank as the case may be and maximum clearance over tank top required for taking out the bushing.
- Tank Earth pad details.
- Core grounding details through terminal board or bushings suitable for 2 kV AC (one minute) isolation test. In case of large transformers (100 MVA and above) the core, core clamp connections shall be brought out independently at tank cover in a terminal box and earthed to ground.
- OLTC diverter switch to main tank equalizing details (applicable in case of OLTC only)
- Transformer center line (reference line) shall be the center line of rail gauge.
- Overall dimensions and maximum dimensions on either side of Transformer center line shall be indicated.
- Show dimensions up to bushing top terminals from rail level for interface between Transformer and station equipments.
- Show the height and other co-ordinates upto bus duct/SF₆ duct and cable pot head mounting with a tolerance of ±10mm
- All dimensions to show the height shall be from rail level, until and unless specified in technical requirement.

- Transformer pull out direction shall be marked and make sure that there are no obstructions for pulling out transformer from the foundation.
- Make sure the jacking pad position is not fouling with the rail line.
- OLTC conservator shall preferably be at same level as main conservator level.
- Buchholz relay shall be accessible for inspection, preferably from tank top.
- Accessibility to ladder and from ladder to tank top shall be clear from other accessories and pipelines. Ladder shall be provided with anti-climbing device.
- Positioning of cable box shall not be in the path of transformer dragging out path.
- It is preferable to mount the coolers on the transformer tank instead of separate mounting.
- Dial of magnetic oil level indicator shall be visible from the ground.
- Provision shall be made on tank cover for fixing safety barriers.
- If air cell is provided in the conservator, air cell failure indication (by air operated relay or oil sight window) shall be provided.
- Upper filter and sampling valves shall be accessible from ground level. All valves shall be provided with identification labels.
- Rating and diagram plate shall be visible and near to OLTC driving mechanism. Marshalling box with indicators shall be near to it. Dials of all indicating and protection meters shall be visible clearly when viewed from the front of transformers.
- Following notes and cross reference document numbers shall be given.
 - Tolerance on weights and dimensions will be $\pm 5\%$ unless marked separately.
 - External painting system and shade number e.g. shade number (631 of IS:5), epoxy zinc primer + epoxy intermediate + polyurethane paint (preferred system)
 - Document number of Bill of Material for cross reference, if accessories are listed up in a separate drawing
 - Drawing numbers of Rating & diagram plate, Valve schedule plate, Foundation plan, Transport dimension and bushings.
 - Design features generally meet the statutory, regulatory and safety requirements in terms of earthing arrangement, danger / warning labels, air clearances and provision of pressure relief device, gas operated relay and earthquake withstand clamping to foundation.
 - Terminal Connector shall be arranged by Customer.

4.3 List of Accessories

- List of Accessories can be on separate sheets. GA drawing number shall be given as a cross reference.
- Description, Make and quantity of all accessories shall be given.
- Items disassembled for transport shall be indicated clearly.
- Mercury filled actuating switches shall be avoided in all accessories.

4.4 Bill of Materials

- Bill of materials shall be on separate sheets. One or more A4 / A3 sheets can be used. GA drawing number shall be given as a cross reference.
- Description, Make and quantity of all accessories shall be given.

4.5 Foundation Plan

- Constructional and fixing details of foundation bolt.
- Foundation bolts shall be under the scope of transformer supplier. Grouting of bolt shall be done at the time of transformer erection for matching purpose.

- Load on each support shall be clearly stated.
- Transformer Pull out direction shall be marked in line with GA
- Foundation bolt shall be part of BOM.
- Rail gauge shall be marked in foundation drawing.
- Anti-earthquake features in foundation/clamping (in case of transformers for seismic zones).

4.6 Bushings

- Bushing shall be as per latest relevant IS/IEC/CBIP specifications
- Short time current rating shall be 25 times rated current for 2 second up to 4000 A bushing and 100 kA for 2 second for bushings above 4000 A as per IS/IEC, or as specified by Purchaser.
- Maximum angle of inclination and cantilever strength shall be indicated.
- Arcing horns are not recommended for the bushings.
- Material of components shall be indicated.
- Weight of oil and bushing shall be indicated.
- Bushing top terminals shall be marked.
- Test tap details shall be shown in bushing drawing.
- Creep distance shall be 31 mm / kV for all bushing upto 420 kV in open air. Creep distance is not applicable for oil to oil to SF₆ bushing. Creep distance for bushing inside cable box / bus duct shall be 20 kV / mm minimum.

4.7 Transport Dimensions

- Center of Gravity during Transport condition must be clearly marked.
- Transport condition (oil filled /gas filled) shall be indicated. In case of gas filled, clearly identify whether it is Dry air or Nitrogen. Gas filled transport shall be with a positive gas pressure.
- Transport weight shall be clearly indicated.
- Lifting bollards / Jacking Pads / Lashing lugs and Pulling eyes shall be identified.
- Impact recorder location (if applicable)
- Direction of transport movement shall be indicated.

4.8 General arrangement Drawing of Marshalling box / Cooler Control Cubicle

- Cubicle shall be according to guide lines in CBIP Transformer Manual.
- Degree of protection shall be IP:55
- Glass window shall be at a level to view the temperature indicators.
- Undrilled gland plate for use by customers shall be provided.
- External & internal Paint type and colour shade shall be indicated.
- Cable and lug size shall be specified along with gland sizes.

4.9 General Arrangement Drawing of RTCC Panel

- RTCC panel shall be suitable for IP:41 degree of protection.
- External & internal Paint type and colour shade to be furnished.
- Not more than two wires shall be taken from any terminal

4.10 General Arrangement Drawing of Junction Box (if applicable)

- In case of floor mounted M/Box, a separate junction box shall be mounted on transformer to terminate all wirings.
- Interconnection between junction box to M/Box to be done at site.
- Junction box shall be suitable for IP:55 degree of protection

4.11 Tap changer control scheme

Tapchanger

4.11.1 Besides the local and remote electrical control, on-load tap changers, when specified, should be suitable for remote electrical parallel control as in clause 4.11.2.

4.11.2 Remote Electrical Parallel Control (Figure 3.1)

- In addition to the methods of control as in clause 2, the following additional provision shall be made.
- Suitable selector switch be provided, so that anyone transformer of the group can at a time be selected as 'Master', 'Follower' or 'Independent'.
- Necessary interlock blocking independent control when the units are in parallel, shall be provided.
- The scheme will be such that only one transformer of a group can be selected as 'Master'.
- An out-of-step device shall be provided for each transformer which shall be arranged to prevent further tap changing when transformers in a group operating in 'Parallel control' are one tap out-of-step.

4.11.3 On-load Tapchanger Control Scheme

A. The control scheme for tap changer can be as under:

- Non-automatic independent - The scheme used for independent control from local or remote panel.
- Non-auto / automatic independent - The scheme used for independent control with automatic voltage control relay and line drop compensation as optional. If required, non-auto condition can be availed.
- Non-automatic simultaneous parallel operation - The scheme used for non-automatic simultaneous parallel operation.
- Non-automatic / automatic simultaneous parallel operation - The scheme used for simultaneous parallel operation with automatic voltage control relay and line drop compensation as optional. If required, non-auto condition can be availed.

B. General

- Local control items shall be mounted inside the on-load tap changer driving mechanism or marshalling box. Remote control items are to be mounted on remote control cubicle installed in the control room. All the control items are to be mounted in easily accessible position and clearly labeled. All control item shall be of best quality and or class most suitable for working under the conditions specified and shall withstand the variation of temperatures and atmospheric condition arising under working conditions so also withstand vibrations. All control items shall be wired and connected as per 'Schematic Diagram of tap changer control equipment given in Scheme .

4.11.4 Motor

On-load tap changer driving gear Motor shall be of squirrel cage totally enclosed type and shall comply with Indian Standard IS: 325. It shall be suitable for direct starting and continuous running from 415 volts 3-phase 50 Hz supply. Motor shall be capable of continuous operation at any frequency between 48 and 51.5 Hz together with any voltage within 10 per cent of nominal value. Motor shall have ball or roller bearing and vertical spindle motor shall have bearing capable of withstanding thrust due to the weight of the moving parts. The stator windings shall be adequately braced and suitably impregnated to render them non-hygroscopic.

4.11.5 Overload Protection Relay

The overload protection relay shall be of robust, adjustable triple-pole construction. It should provide accurate and reliable protection against overload, single phasing, overheating and short circuit. The relay should be provided with temperature compensating device to off-set the effect of ambient temperature variation. For single phase motor, over-load protection device with feature similar to those of the three-phase motor as far as these are applicable shall be provided.

4.11.6 Contactors / Relays

Contactors / Relays shall be of robust and compact construction and shall comply with Indian Standard IS : 2959. The electromagnetically operated air break type contactor with sufficient number of contacts shall be suitable for mounting on a vertical supporting structure. The contactors shall be suitable for operation at 110 Volts A.C. -15 per cent to + 10 per cent 50 Hz. Main and auxiliary contacts of contactor shall be suitably rated. For sufficient long life, these contacts shall be break type and shall make contacts practically bounce-free.

4.11.7 Control Supply Transformer

The control supply transformer shall be single phase having ratio 415/55-0-55V. It's insulation shall be suitably impregnated to render it non-hygroscopic.

4.11.8 Control Selector Switches

All the control selector switches shall be of robust and compact construction and shall comply with Indian Standard IS : 4064 and 4047. The control switches shall be suitable for on-load switching of resistive and inductive loads. The switches shall incorporate multi air break type wiping contacts housed in an assembly of packets moulded from anti tracking material. The knob of the handle of the switch shall be suitably designed so that while operating a firm grip is obtained.

4.11.9 Remote Tap Position Indicator

Remote tap position indicator mounted on remote control panel shall show accurately same tap position as indicated by local tap position indicator on on-load tap changer. The remote indication can be by means of a digital indicator. Transmitter switch in the driving gear shall be make before break type. This switch in the driving gear shall be mounted in accessible position so that it can be cleaned and maintained regularly. The remote indicator mounted on control panel shall not be affected by normal auxiliary voltages supply variation.

4.11.10 Indicating Lamp and Indication Circuit Diagram

Necessary indicating lamps provided shall be of low watt consumption and of filament type or Neon or LED type. Lamps shall be of such construction so that these can be replaced very easily. Typical Indication Circuit diagram for RTCC panel is attached as Fig. 3.2.

4.11.11 Space Heater

Space heater of adequate capacity and robust construction shall be provided inside each control cabinet to prevent moisture condensation. Space heaters shall be rated for 240 volts 1 phase, 50 Hz supply. Heater shall be complete with miniature circuit breaker. Mounting of the heater and its location shall not cause localized intensive heating of control equipment and wiring.

4.11.12 Wiring

All the wiring shall be carried out for motor circuit with 1100 volts grade PVC insulated stranded copper conductors of size 2.5 sq mm and for control circuit with 650 volts grade PVC insulated copper conductor of size 1.5 sq mm suitable for tropical atmosphere. All wiring shall be in accordance with relevant IS. Engraved core identification ferrules, marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires and shall not fall off when the wire is removed. All wiring shall be terminated on terminal blocks through suitable lugs. Insulated sleeves shall be provided at all the wire terminations. All wiring shall be neatly bunched and cleated without affecting access to equipment mounted within the cabinet. One piece moulded 600 V grade terminal blocks complete with insulation barriers, terminal studs, washers, nuts and lock nuts shall be used. Terminal blocks shall be numbered for identification and grouped according to function. 10 per cent spare terminal blocks for control wire termination shall be provided on each panel. Terminal board rows should be spaced adequately apart to permit convenient access to wires and terminations. Terminal boards shall be so placed with respect to the cable gland plate (at a minimum distance of 70 mm) as to permit satisfactory arrangement of multi core cable tails without undue stress or bends. Opening of door should not disturb or stress the wire termination.

4.11.13 Voltage Regulating Relay

(i) **Introduction:** Voltage Regulating Relay is used for regulating the secondary voltage of power

transformers with on-load tap changers. The required dead band settings are set by setting the nominal value, and lower and upper levels independently. The time delay setting on the front panel eliminates the relay operations for momentary fluctuations of the regulated voltage thus reducing the number of operations of the tap changer. " When the regulated voltage falls below the specified under voltage limit, the control relays are automatically blocked, i.e., there is no voltage correction, and a pair of contacts is made available for alarm.

- (ii) **General Description:** Voltage regulating relay should be designed for maximum operational simplicity for regulating the secondary voltage of power transformer with on load tap changers. The dead band (band width) can be set by setting the nominal value adjustment (NVA) to the required value "110 V + 10 per cent".

The desired time delay can be set on the front panel and the control action will take place only if the voltage continues to remain outside the dead band after the time delay has elapsed. For voltage corrections requiring more than one tap change, time delay is initiated again before further tap change. The relay is reset automatically after the voltage is brought within the selected dead band. For repeated short duration voltage fluctuations on the same side of the dead band, the time delay is effectively reduced to provide a voltage time integral response of the regulator. Operation of the Raise Control relay is automatically inhibited when the voltage falls below the specified under-voltage limit. One pair of normally open relay contacts are provided to effect the tap changer, Raise and Lower operation and to trigger an alarm in case of under voltage conditions.

- (iii) **Specifications**

Auxiliary Supply : -15% / + 10% 50 Hz

PT Supply (regulated Voltage) : 110 V \pm 10 per cent 50 Hz

Sensitivity (Dead Band) : Nominal value adjustable (NVA)

and Nominal Value Range between + 0.75 to + 2.5 per cent

Time Delay Setting: Fixed, i.e., (Voltage independent) time delay continuously adjustable from 10 to 110 secs.

Time Delay Resetting: Instantaneous resetting with voltage deviation occurring in opposite direction.

Under Voltage Blocking: Internal blocking at 80 per cent of regulated value. Restoration at 85 per cent of regulated value.

Control Relays: One pair of normally open potential free contacts of suitable rating.

Control Operation: Single pulsed operation of sufficient duration to initiate tap changer.

Operating Temperature : - 5° to + 50°C

Option: Line drop compensator with resistive and reactive compensation of either polarity up to 20 per cent adjustable in steps or continuously and suitable for operation with 1 Amp. current transformer. If required suitable interposing current transformer to be used to get 1 Amp. Secondary current.

1 pair of NC (UV) contacts provided.

4.11.14 Line Drop Compensator (LDC) : Description

- i. The Line Drop Compensator is an optional unit designed to match with the Automatic Voltage Regulator Relay. The unit is housed in the same enclosure or separately mounted.

The voltages at the generating end and at the receiving end are not the same due to the drop across the line. The LDC is used to compensate for this line drop, and the amount of compensation required is calculated as a per cent of the nominal voltage knowing the length of the line, its resistance/unit length, its reactance/unit length and the rated current, and set on the front panel.

The line current is stepped down to 1 Amp. & fed to the LDC. The resistive and reactive drops are simulated by having 90° phase shifted voltage and their polarity selected by polarity switches. The net compensation is then fed to the stepped down PT voltage.

ii. Specifications

Resistive Compensation: 0-20 per cent of the regulating value continuously adjustable.

Reactive Compensation: 0-20 per cent of the regulating value continuously adjustable.

Input Rated Current: 1 Amp. 50 Hz.

Power Consumption: As required (CT burden will depend on power consumption).

Accuracy : 10 per cent.

Max. Overcurrent : 50 per cent of rated current (1.5 Amp.)

Polarity Selection : Both positive and negative compensation.

iii. Operating and Connection Requirements

Connection to the LDC unit are made through the rear panel terminals. The line current is stepped down to 1 Amp. 50 Hz and fed to the LDC. The net compensation is fed to the AVR circuit internal or external connections.

The required amount of percent R and per cent X compensation can be set on the front panel of the LDC. The polarity selector switches provide both positive and negative compensation. The per cent R and per cent X settings can be calculated from the following formulae:

$$\sqrt{3} \cdot I_L \cdot R_L$$

Per cent R = x 100 per cent

Per cent X = x 100 per cent

Where, I_L = the primary rated current of the line.

V_L = the voltage between lines of the power transformer.

X_L = the line reactance in ohms/phase.

R_L = the line resistance in ohms/phase.

Note : When LDC unit is not to be used, keep per cent R and per cent X settings to Zero, i.e., on minimum position.

4.11.15 Local Electrical Operation

This is possible only in the independent position. Set the switch 'S32' to Local position in D.M. Box. When switch 'S32' is kept on Local Mode, the control supply is made available to the Raise/Lower switch in D.M. Using the Raise/Lower switch, Local Electrical Operation can be carried out.

4.11.16 Remote Electrical Operation

Remote Electrical Operation is carried out as follows :

Select one Transformer as "Master" and others as its 'Followers'. Then control supply will be tapped from D.M. Box to RTCC panel. Through the S/W S5 in RTCC1, which is set at 'Master' mode the Control supply is passed on to S/W S40 in D.M.1 which is an Odd/Even type of S/W. Its every 2nd position is linked e.g. 1, 3, 5, 7, 9, 11, 13, 15, 17 etc. This is to reduce number of interconnecting wires between RTCC panels. Suppose, Transformer 1, which is set as a "Master", is at Tap 1, then through its odd/Even S/W in D.M.1, the Control Supply now goes to RTCC2 and from there it goes to Odd/Even S/W S40 of D.M.2. If the D.M.2 is also at Tap 1, then the control supply will be returned to RTCC2 set at "Follower" mode and energizes Contactor K11 in RTCC2. Normally Open Contact of this K11 is wired up in RTCC1 and once it becomes closed, supply is available at Auto/Manual S/W S9, in RTCC1.

If the S/W S9 is set at Manual mode, then thro' Push Button S1 or S2 Raise/ Lower operation is carried out. S1 will energize Contactor K4 for Raise tap and S2 will energize K5 for Lower contactor. Once the Raise or Lower Contactor in Master RTCC is picked up, it will extend the command to Follower RTCC to Raise or Lower Contactor and hence tap will be changed in both Transformers

simultaneously. If the Tap change operation is not completed within prescribed time duration, then the Timer is energized in D.M. Box which indicates Tap Change incomplete indication and D.M. MCB is tripped. Contactor K6 in RTCC will act as a Blocking relay which will block the Tap Change operation in case both RTCC' s are not at same Tap position. In that case the timer K29 is picked up and will indicate Tap change Out of step indication.

Remote Auto Operation:

Remote Auto Operation is carried out as follows:

Set Auto/Manual S/W S9 on Auto Mode. The Raise/Lower Tap position decision is taken care by Automatic Voltage Regulator. As per its instruction either K4 or K5 is energized and then it gives command to Follower RTCC accordingly.

4.12 Cooler Control Scheme

Cooler control systems follow different practices and vary depending upon customer specs, manufacturers standard practices, however, standard control schematic will allow end customer to operate cooler control with more ease and similar representation of schemes and ease of maintenance. For cooler control schematics, standardisation of schemes will lead only to way of representation and mode of control like Auto/Manual or Local/Remote. Typical Cooler Control Circuit is attached as Fig. 3.3.

The standard methods for drawing are as follows:

4.12.1 Index






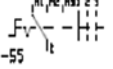

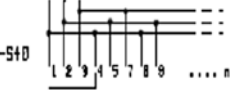
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	TERMINALS		CONTACTOR
	PUSH BUTTON		TIMER
	NORMALLY OPEN CONTACT		SEQUENCE SELECTOR SWITCH
	NORMALLY CLOSED CONTACT		ODD/EVEN SWITCH FOR PARALLEL OPERATION

Fig. 3.1: Type of symbols

A. Device Designation

Terminals to be defined in the following way:

All terminal number strips will start with letter "X" and prefixed by "-". Individual terminal number will follow with ":".

e.g. -X1: 12.

All contactors and Timers to be designated starting from letter "K" and prefixed by "-".

e.g. -K5.

All MCBs and Phase failure relays to be designated with letter "F" and prefixed by "-".

e.g. -F1.

All control switches, sequence selector switches and push buttons to be designated with letter "S" and prefixed by "-".

e.g. -S2.

AVR and annunciators to be designated with letter "A" and prefixed by "-".

e.g. -A1.

Indicating Lamps to be designated with letter "H" and prefixed by "-".

e.g. -H1.

Instruments like signal converter or Transducers, power supply module etc to be designated by letter "U" and prefixed by "-".

e.g. -U2.

MPCB (Motor Protection Circuit Breaker) to be designated by letter "Q" and prefixed by "-".

e.g. -Q10.

B. Ferruling and Signal linking

Where ever ferruling is required, it should be cross ferruling, indicating connection point near connection and originating point after it for easy tracing in the event of fault finding.

e.g.

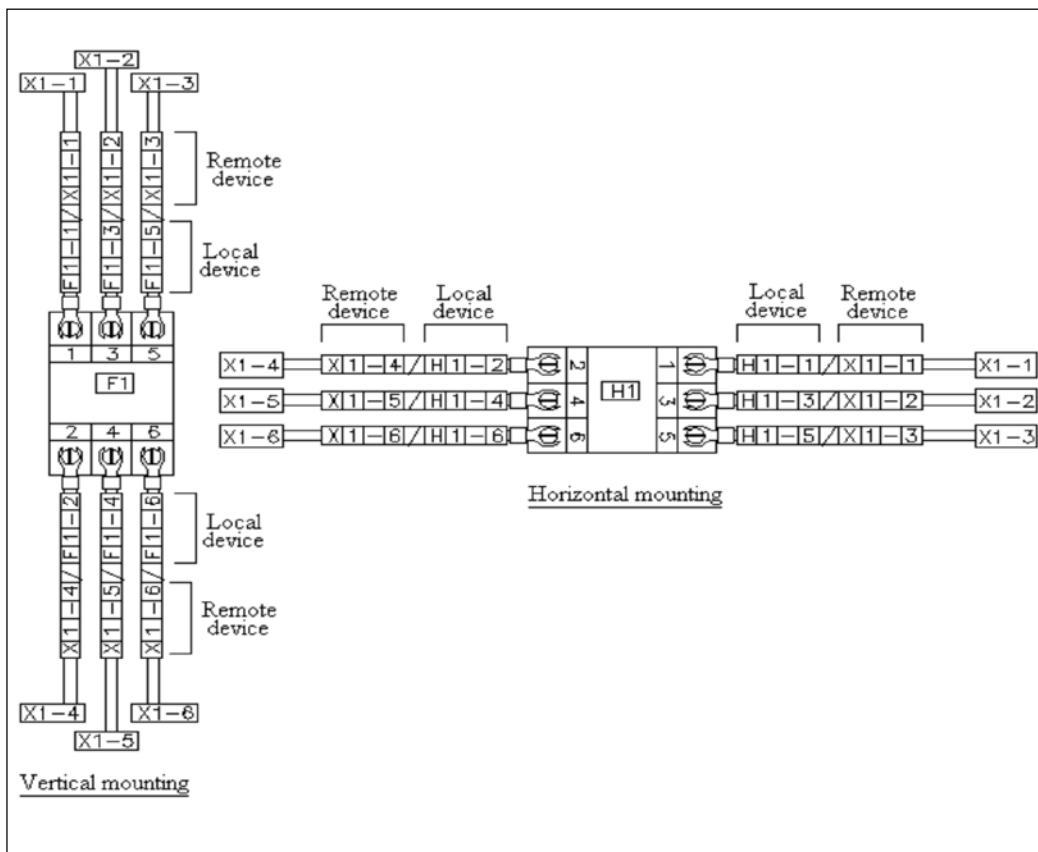


Fig. 3.2

Where control schematic drawings are prepared in A3 or A4 size sheets, signal linking has to be done in following fashion:

Signal designation to start with letter "L" followed by signal number followed by the destination sheet and column in which destination is located. e. g.. --L1/5.2. In this example, signal L1 is terminated on 5th sheet and in 2nd column.

C. Designation of Devices used in proposed scheme

Devices used in the attached drawings are:

Sr. No.	Instrument	Purpose	Location
1	K4	Impulse relay for Raise Tap command	RTCC
2	K5	Impulse relay for Lower Tap command	RTCC
3	K6	Blocking Relay	RTCC
4	K11	Parallel Operation ready relay	RTCC
5	K29	Timer for Out of step indication	RTCC
6	S1	Push button for Raise Tap	RTCC
7	S2	Push button for Lower Tap	RTCC
8	S3	Push button for Emergency stop command	RTCC
9	S5	Master/Follower/Independent Selection Switch	RTCC
10	S9	Auto/Manual Selection Switch	RTCC
11	S40	Odd/Even Switch	D.M.

4.13 Alarm and Tripping Scheme

As per drawing (Figure 3.4).

4.14 Interconnection between DM & RTCC

As per drawing (Figure 3.5).

4.15 General Arrangement Drawing for Air filled Cable Box (If applicable)

- Number & size of cables/phase as per customer specification shall be indicated.
- Cable box shall be provided with silica gel breather.
- Provision shall be made to move the transformer without disturbance keeping cable box in position.
- Earthing links shall be provided between cable box, disconnecting chamber and cable gland plate.
- Minimum one meter distance shall be provided from gland plate to bus bar.
- External Painting procedure of tank shall be applicable for both inside and outside of cable box.
- In case of ground mounted cable box support, same shall be in line with foundation plan.
- Cable Lugs and glands are not part of transformer supply.
- All bus bars and flexible inside the cable box shall be tin plated.
- Epoxy or porcelain insulator shall be used inside the cable box for bus bar support with minimum creepage distance of 20mm/kV

4.16 General Arrangement Drawing for Bus Duct termination (if applicable)

- Position of bus duct mounting flange shall be dimensioned from transformer center line and from rail level with a tolerance of ± 5 mm.
- Electrical clearance boundary shall be indicated so that bus duct (supplier scope) should not enter into the minimum clearance zone.
- Bushing top terminal details shall be clearly indicated for further connection by bus duct supplier.
- Drain plug shall be provided at the bottom most point of bus duct fixing flange on transformer.

4.17 Valve Schedule Plate

- All valves, air vents and drain plugs shall be shown in valve schedule plate.
- Table shall contain, type, size, material and quantity of valves.

- Open and close indication of each valve at service, transport and oil filling should be marked.
 - In case of water cooled Transformers, a heat exchanger single line diagram is required.
5. **Typical Cable Schedule is enclosed for reference (Annexure 3.2).**
6. **Over and above, following drawings may also be generated if required:**
1. Cooler Diagram plate
 2. GA of common marshalling box (for 1-phase transformers)
 3. GTP (Technical data)
 4. Neutral formation Drawing (for 1-phase transformers)
 5. Combined foundation Drawing (for 1-phase transformers)
 6. Test plan/procedure.
 7. Others – Oil filling instruction, nitrogen fire protection system etc. if applicable.
 8. QAP, FQP, TTR, Erection manual shall be submitted.
 9. Disposal plate
 10. Roller Drawing
 11. Terminal Connector details (if applicable)

ANNEXURE 3.1

Code for Transformer Accessories in line with DIN42513

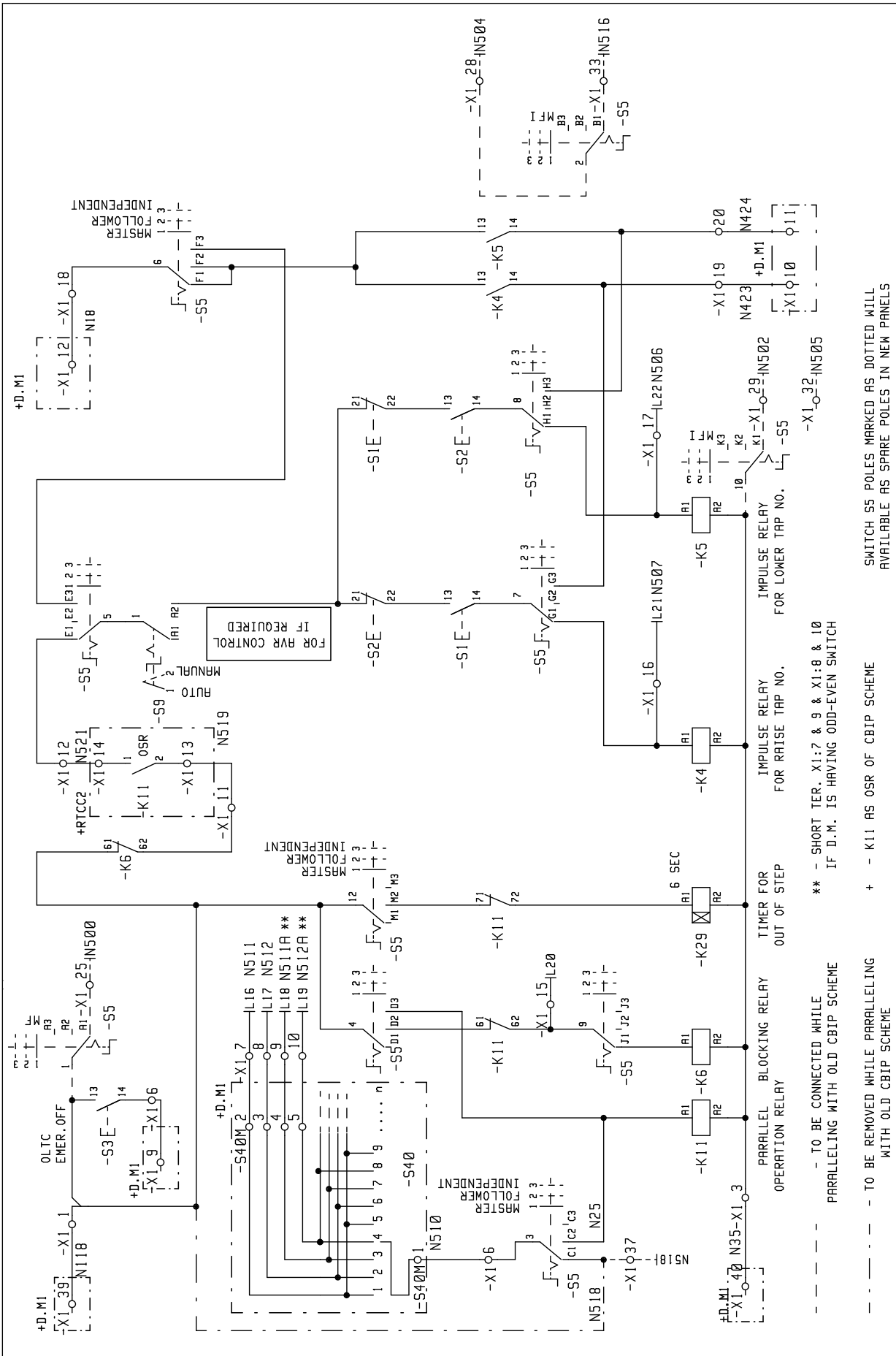
1. AA001~XXX Valves
2. AB001~XXX Drain plugs
3. AC001~XXX Radiators, Oil to water heat exchangers, oil to air heat exchangers
4. AE001~XXX Rollers, skid base, foundation bolts, anti-earthquake locking arrangements, refilling device for dry air
5. AN001~XXX Cooling fans
6. AP001~XXX Cooling pumps
7. AT001~XXX Dehydrating breather, Air cell
8. BB001~XXX Lower tank, upper tank, cover, conservator for main tank, conservator for tap changer
9. BQ001~XXX Thermometer pockets, detachable ladders, jacking pad, lifting lugs, lashing lugs, pulling eyes, hook for safety belt, bracket for conservator, cooler pipe
10. BR001~XXX Pipes
11. BZ001~XXX Manholes, hand holes, inspection windows, terminal for tank earthing, rating plate, labels, valve schedule plate, caution plate, air cell installation notice
12. CF001~XXX Accessories (protective, monitoring) bushings, tap changer, control cubicle, motor for tap changer, impact recorder, terminal connectors.

ANNEXURE 3.2 Typical Cable Schedule

M.BOX		Page	To	MOTOR DRIVE(DM)		Page	CABLE DETAIL	Details
Ter.Strip	Terminal			Ter.Strip	Terminal			
X4	9		--	X1	2		4Sq.mm,4core cable	3 Ph supply for OLTC Motor
X4	10		--	X1	3			
X4	11		--	X1	4			
X4	5		--	X1	6		2.5Sq.mm,2 core Cable	1 Ph AC Supply for Heater ckt
X4	6		--	X1	7			
M.BOX		Page	To	RTCC1		Page		
Ter.Strip	Terminal			Ter.Strip	Terminal			
X5	1		--	X2	8		2.5Sq.mm,19 core cable for indication	TO RTCC Panel For LED Indicators
X5	2		--	X2	9			
X5	3		--	X2	10			
X5	4		--	X2	11			
X5	5		--	X2	12			
X5	6		--	X2	13			
X5	7		--	X2	14			
X5	8		--	X2	15			
X5	9		--	X2	16			
X5	10		--	X2	17			
X5	11		--	X2	18			
X5	12		--	X2	19			
X5	64		--	X2	20			
M.BOX		Page	To	RTCC1		Page		
Ter.Strip	Terminal			Ter.Strip	Terminal			
X5	13		--	X2	27		2.5Sq.mm,16 core cable for Annunciation	To RTCC Annunciator Window
X5	14		--	X2	28			
X5	15		--	X2	29			
X5	16		--	X2	30			
X5	17		--	X2	31			
X5	18		--	X2	32			
X5	19		--	X2	33			
X5	20		--	X2	34			
X5	21		--	X2	35			
X5	22		--	X2	36			
X5	23		--	X2	37			
X5	24		--	X2	38			

TJB		Page	To	RTCC1		Page		
Ter.Strip	Terminal			Ter.Strip	Terminal			
X5	33		--	X5	14		2.5Sq.mm,24 core cable for A-Eberle RELAY	4-20mA i/p TPI to A-Eberle
X5	34		--	X5	15			4-20 mA i/p to TPI indicator
X5	36		--	X1	24			4-20 mA i/p to OTI/WTI indicator
X5	37		--	X1	23			
X5	11		--	X1	40			
X5	12		--	X1	26			
X5	19		--	X1	41			
X5	20		--	X1	27			
X5	27		--	X1	42			
X5	28		--	X1	28			
X5	66		--	X1	38			
X5	67		--	X1	39			
X5	8		--	X5	7			4-20mA i/p HV-WTI to A-Eberle from Lumacense
X5	9		--	X5	8			4-20mA i/p LV-WTI to A-Eberle from Lumacense
X5	16		--	X5	9			4-20mA i/p TV-WTI to A-Eberle from Lumacense
X5	17		--	X5	10			4-20mA i/p OIL to A-Eberle from Lumacense
X5	24		--	X5	11			
X5	25		--	X5	12			
X5	64		--	X5	13			
X5	65		--	X5	13A			
M box		Page	To	RTCC1		Page		
X5	65		--	X5	42		2.5Sq.mm,12 core cable for A-Eberle RELAY	Binary I/p to A-Eberle
X5	66		--	X5	18			
X5	67		--	X5	20			
X5	68		--	X5	19			
X5	69		--	X5	21			
X5	70		--	X5	22			
X5	71		--	X5	23			
TJB		Page	To	RTCC1		Page		
X2	123			X5	1		2.5Sq.mm, 2 core cable for A-Eberle RELAY	CT i/p from LDC CT to A-Eberle
X2	124			X5	2			
TJB		Page	To	RTCC1		Page		
X61	3		--	X5	38		2.5Sq.mm,4core cable for A-Eberle relay	Fan & Pump start from A-Eberle
X61	6		--	X5	39			
X61	12		--	X5	38			
X61	9		--	X5	40			

DM		Page	To	RTCC1		Page		
X1	9		--	X1	1			
X1	10		--	X1	2			
X1	12		--	X1	3		2.5Sq.mm,19 core cable for A-Eberle relay	TAP RAISE & LOWER FROM a-Eberle
X1	13		--	X1	4			
X1	14		--	X1	5			
X1	16		--	X1	30			Emergency stop
X1	33		--	X5	41			Binary i/p to A-Eberle OLTC Loc /rem
X1	34		--	X5	28			
X1	35		--	X5	29			
X1	36		--	X5	27			
CRP		Page	To	RTCC1		Page		
				X4	15		2.5Sq.mm,2 core cable for A-Eberle relay	PT supply Y-B to A-Eberle
				X4	16			
M.BOX		Page	To	TJB		Page		
Ter.Strip	Terminal			Ter.Strip	Terminal			
X5	25		--	X5	1		2.5Sq.mm,24 core cable for M.BOX to TJB interconnection	Cooler control interconnection M.Box & RTCC
X5	26		--	X5	2			
X5	27		--	X5	3			
X5	28			X5	4			
X5	53		--	X1	41			Buchholz,PRD,PNRV & Fire detector signals
X5	54		--	X1	42			
X5	55		--	X1	43			
X5	56		--	X1	44			
X5	57		--	X1	45			
X5	58		--	X1	46			
X5	59		--	X1	47			
X5	60		--	X1	48			
X4	7		--	X4	3			1 Ph. 240V ac supply
X4	8		--	X4	4			
X4	1		--	X4	5			220V DC supply Lumesense
X4	2		--	X4	6			
X4	1		--	X4	1			220V DC Supply RTD
X4	2		--	X4	2			
DM		Page	To	RTCC1		Page		
X1	17		--	X2	1		2.5Sq.mm,12 core cable from DM to RTCC interconnection	common
X1	18		--	X2	7			OLTC motor Trip
X1	19		--	X2	6			TC Supply healthy
X1	20		--	X2	2			Tap changer In progress
X1	21		--	X2	4			OLTC in Local
X1	22		--	X2	5			OLTC in Remote
X1	24		--	X2	3			Tap changer incomplete

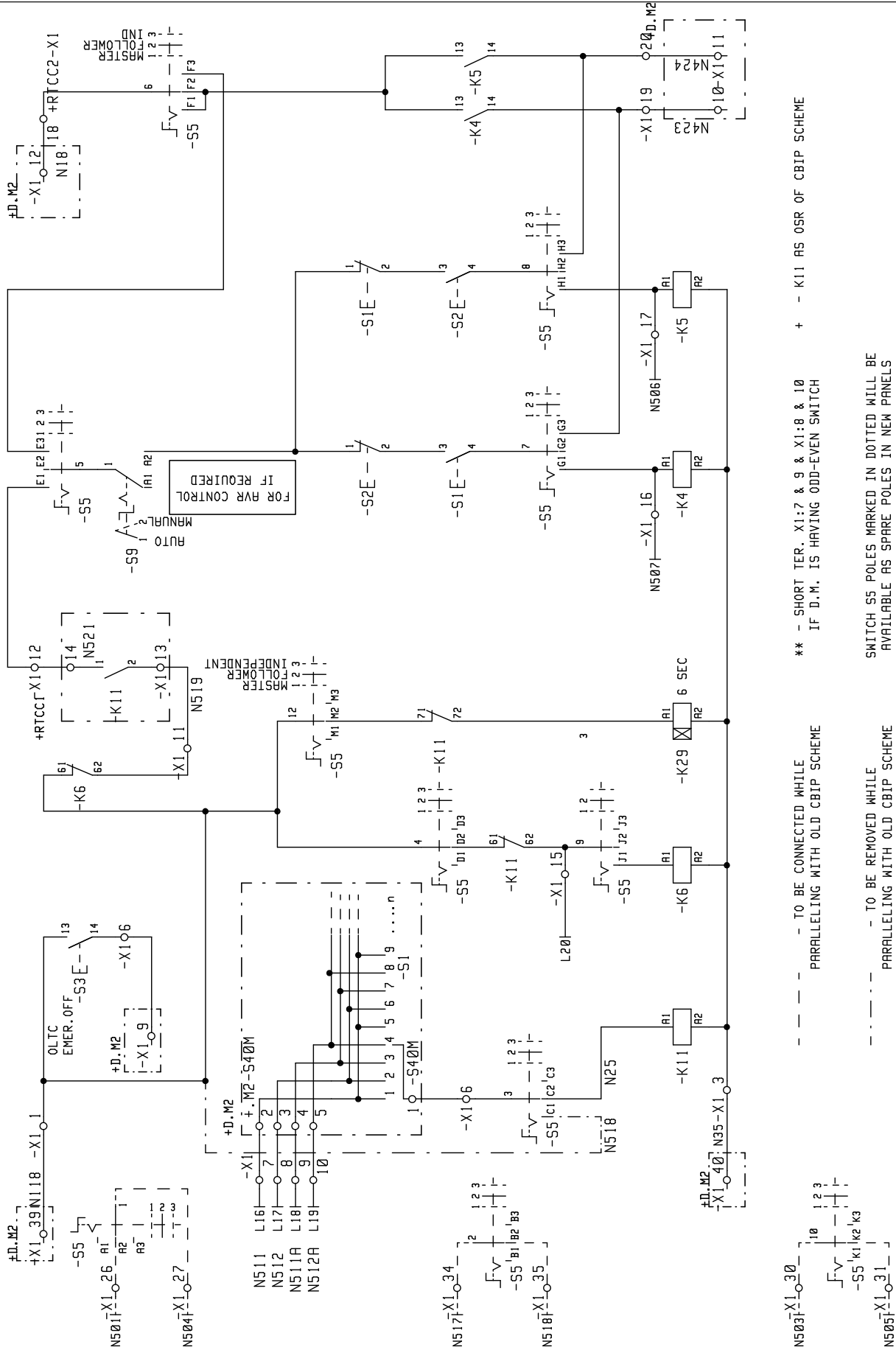


SWITCH S5 POLES MARKED AS DOTTED WILL
BE AVAILABLE AS SPARE POLES IN NEW PANELS

** - SHORT TER. X1:7 & 9 & X1:8 & 10
IF D.M. 15 HAVING ODD-EVEN SWITCH

- TO BE CONNECTED WHILE
PARALLELING WITH OLD CBIP SCHEME
+ TO BE REMOVED WHILE PARALLELING
WITH OLD CBIP SCHEME

Fig. 3.1 (a): Typical Paralleling Circuit Diagram - Master Unit



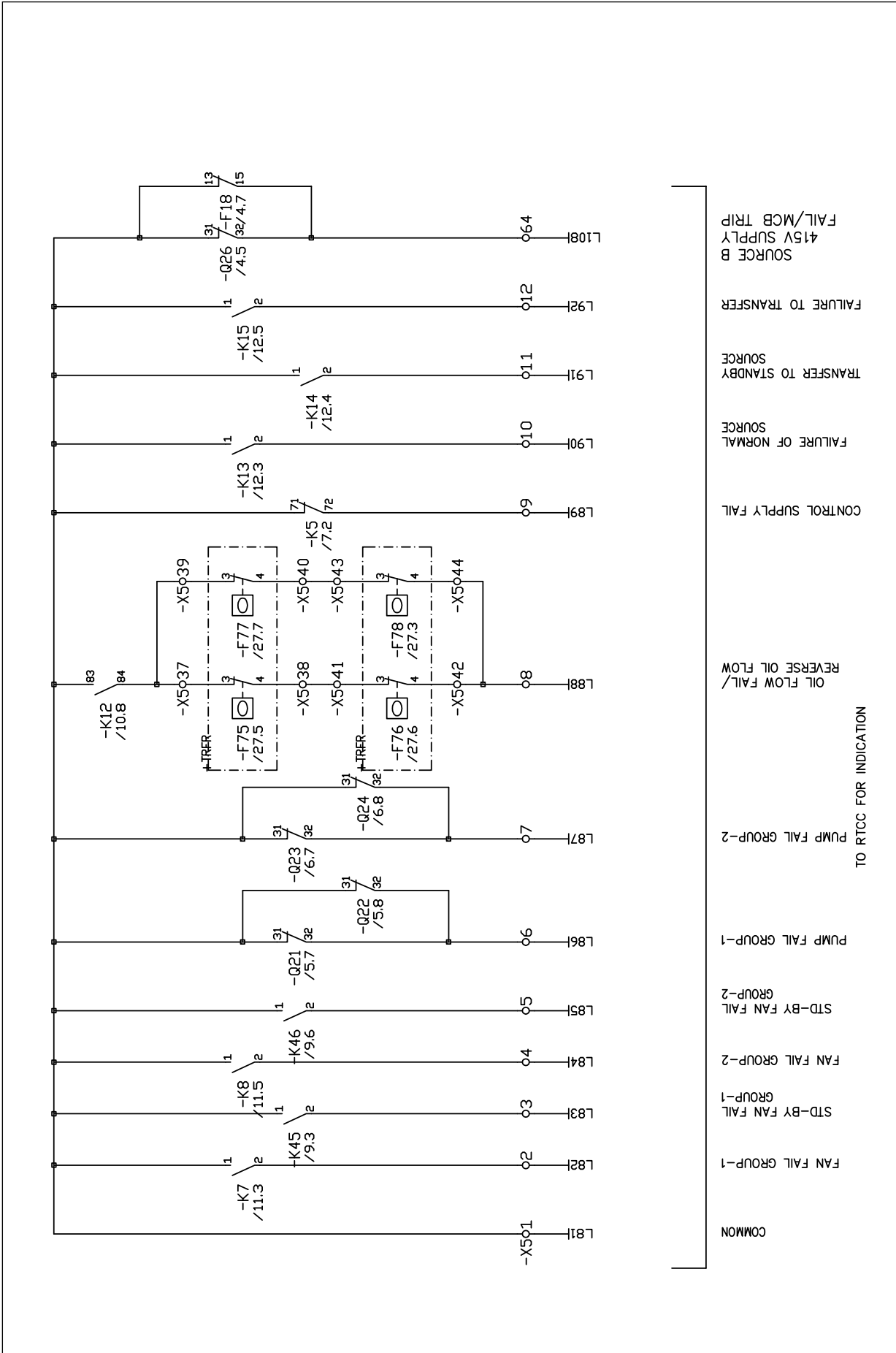


Fig. 3.2 (a): Typical RTCC Indication Signals

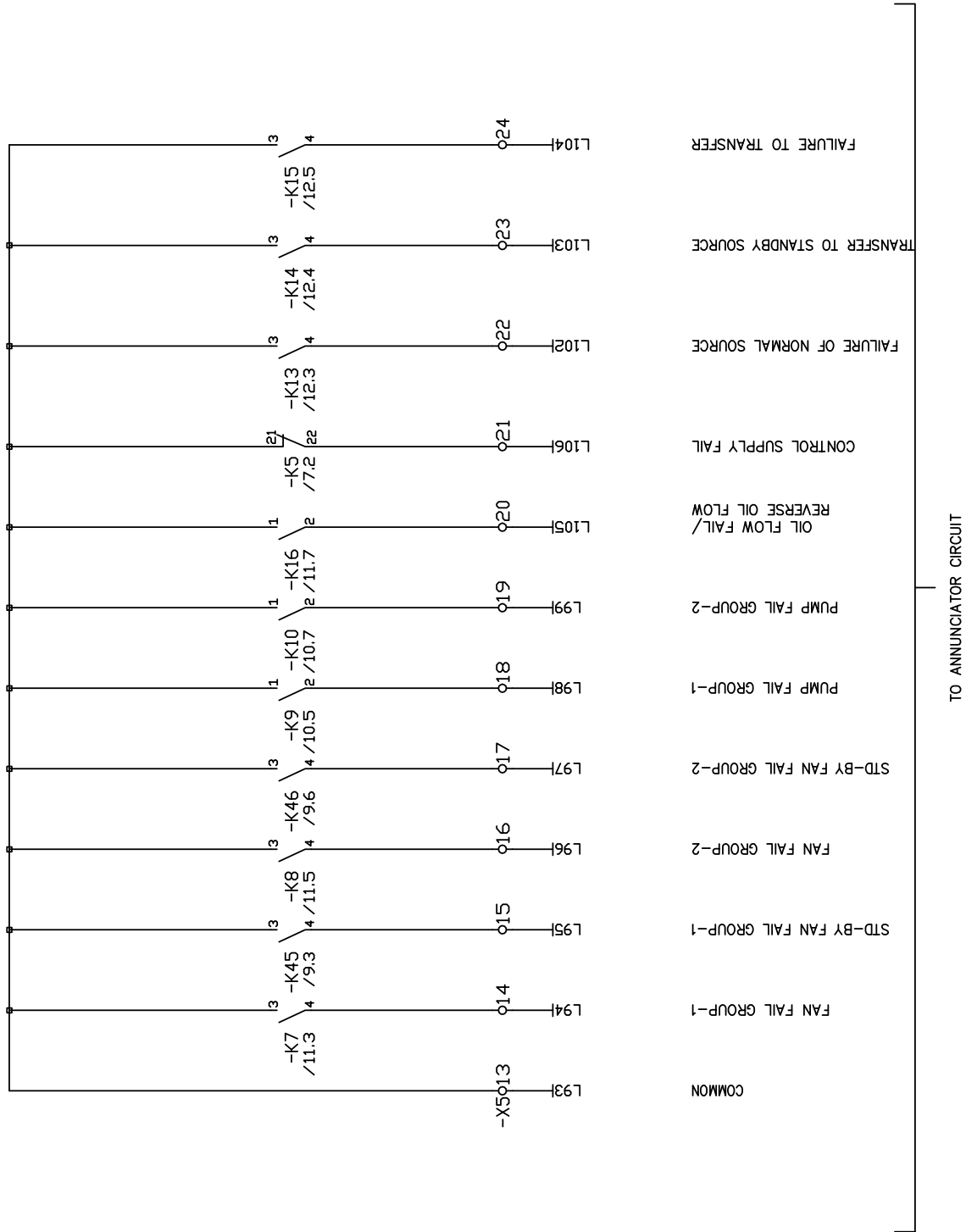


Fig. 3.2 (b): Typical Indication Signals for Customer Panels

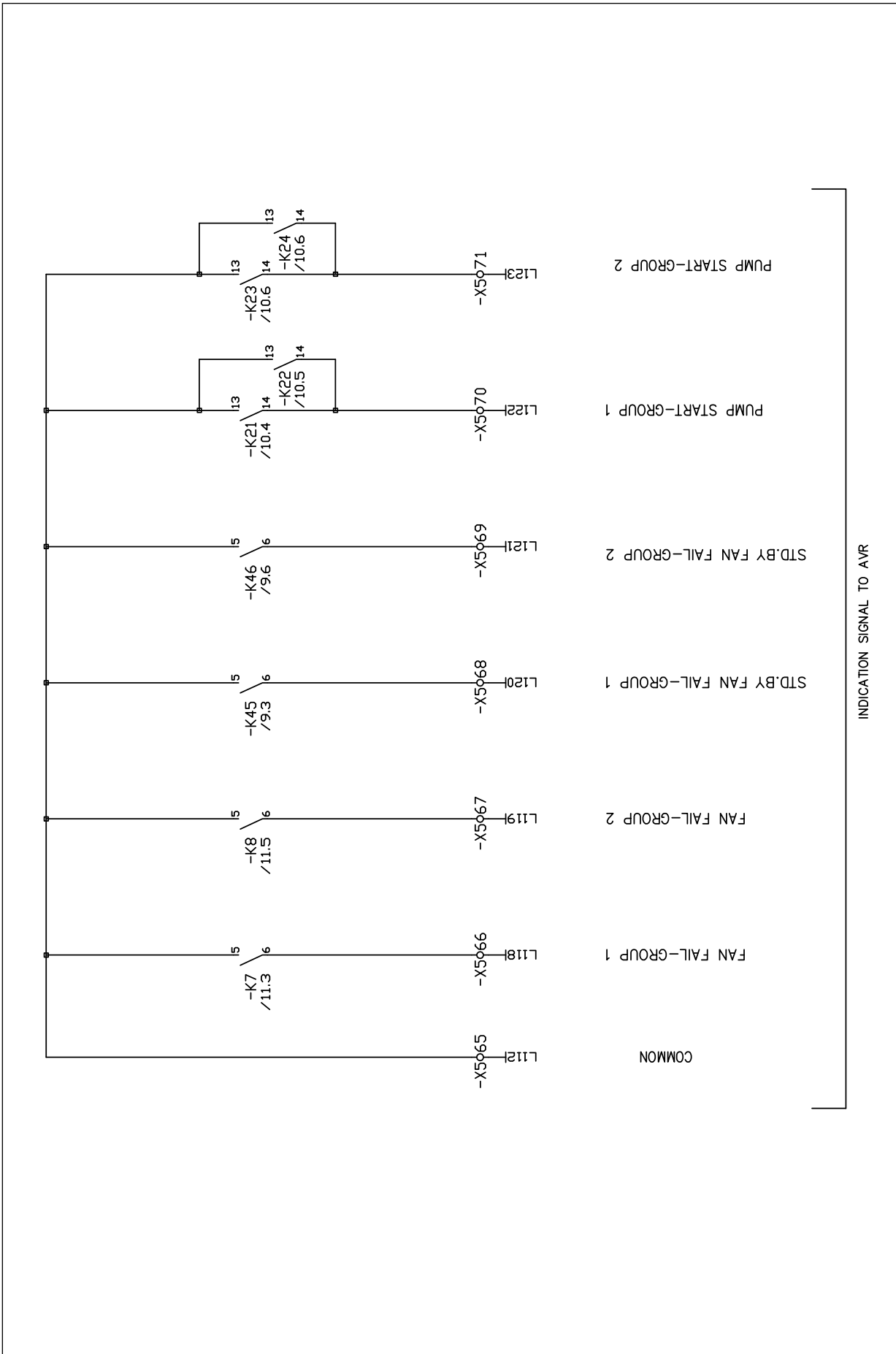


Fig. 3.2 (c): Typical Indication Signals to RTCC

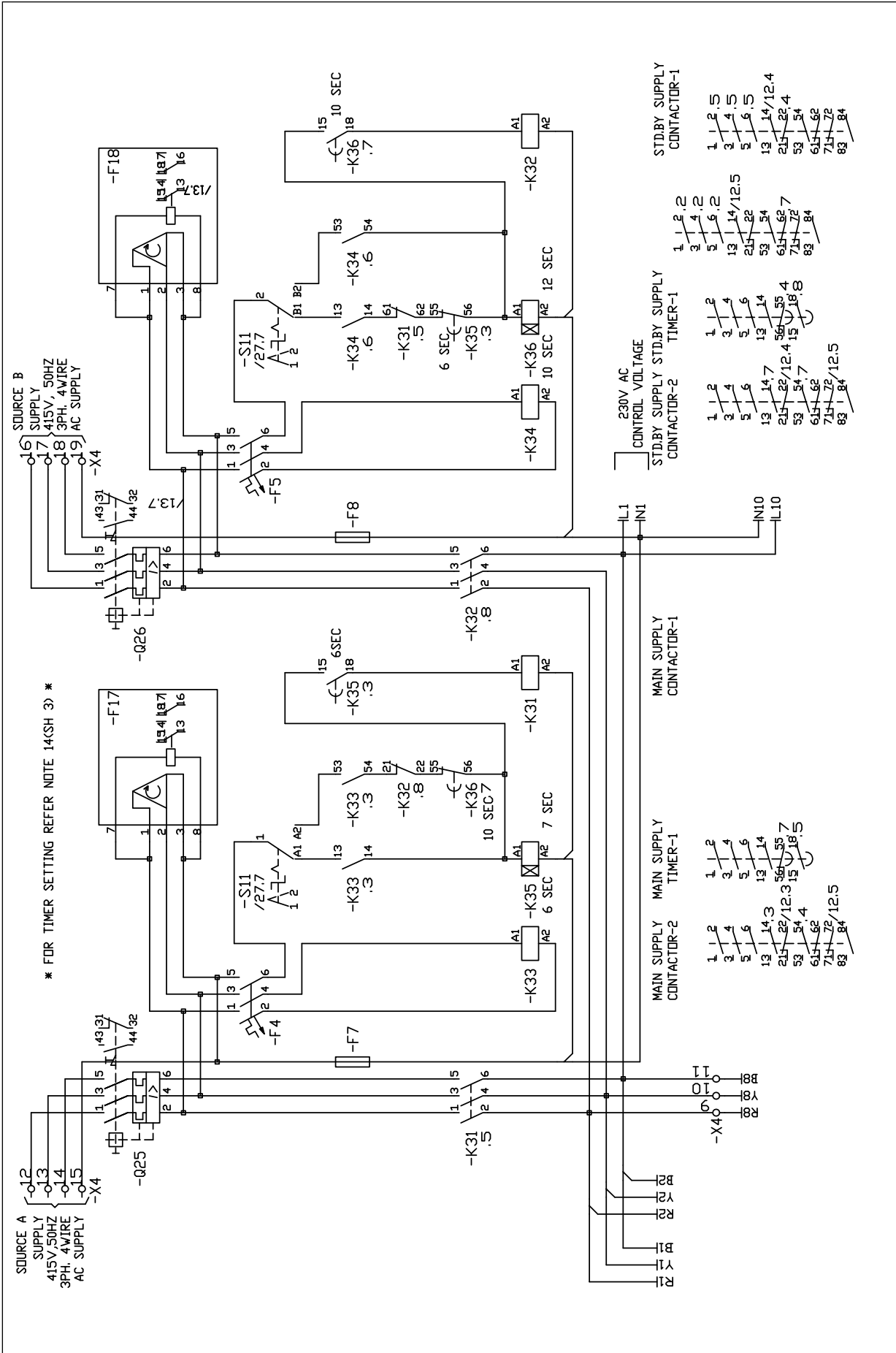


Fig. 3.3 (a): Typical Supply Changeover Circuit

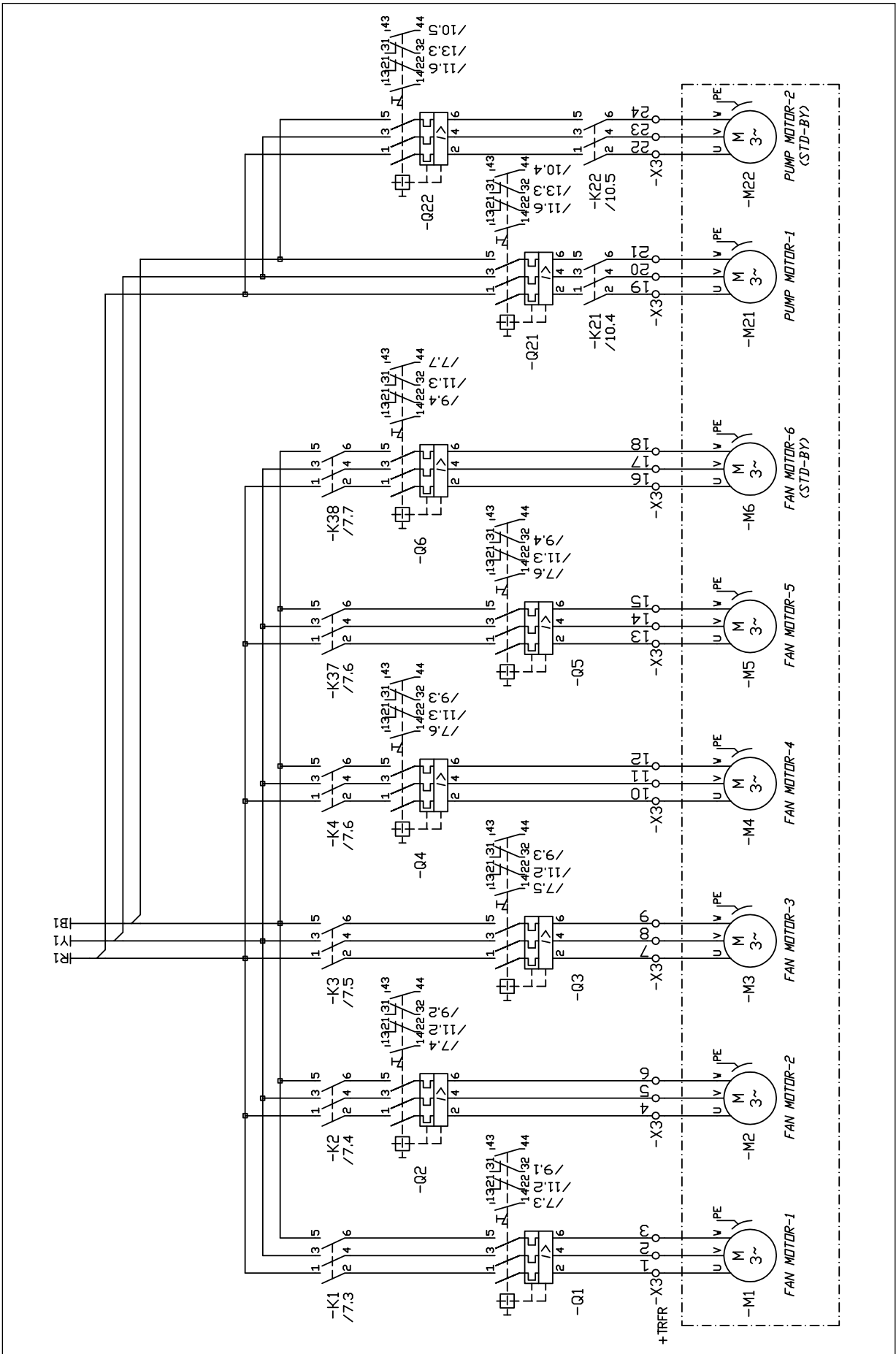


Fig. 3.3 (b): Typical Control Circuit for Fan and Pump Group – 1

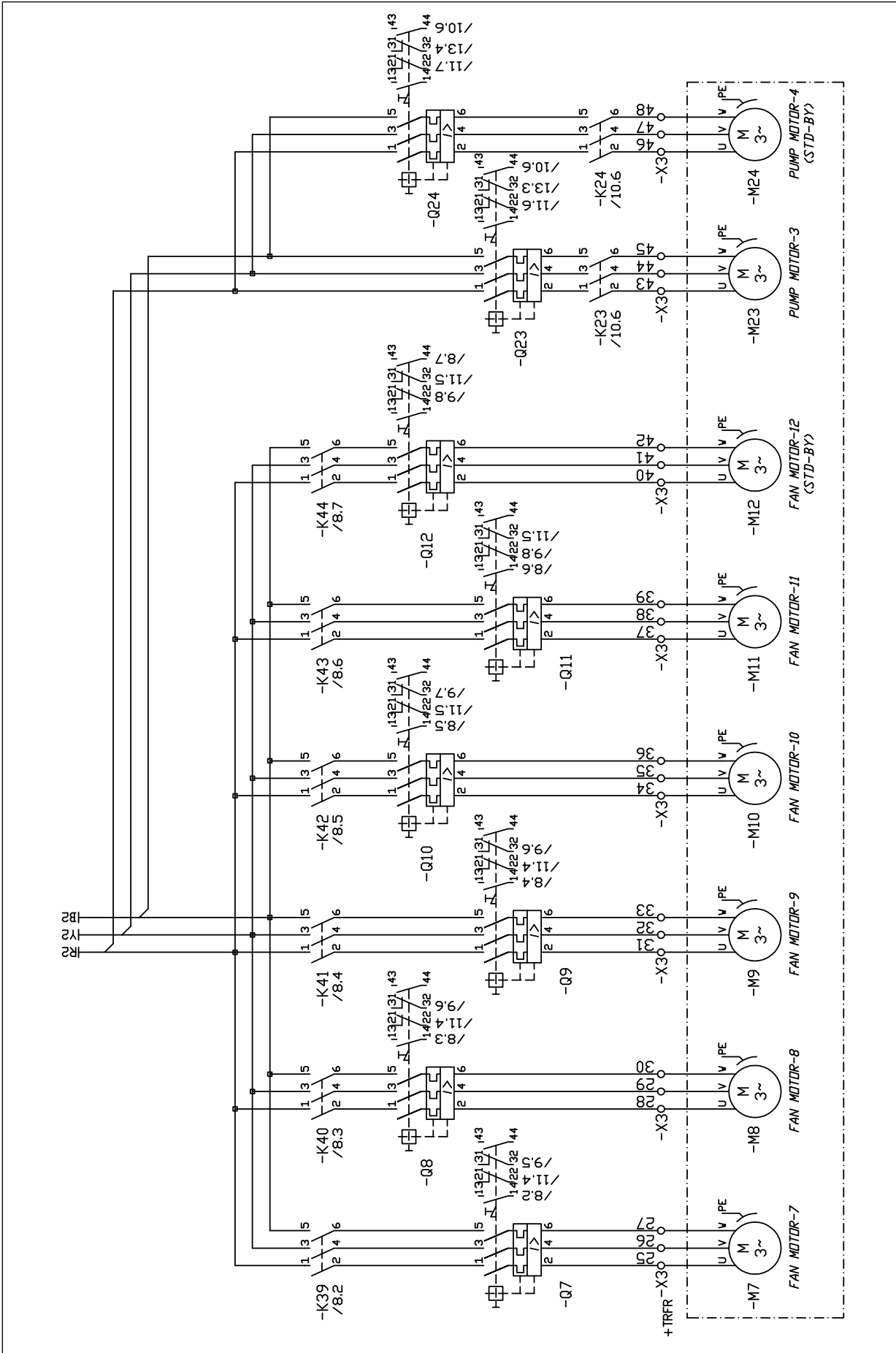


Fig. 3.3 (c): Typical Power Circuit for Fan and Pump Group – 2

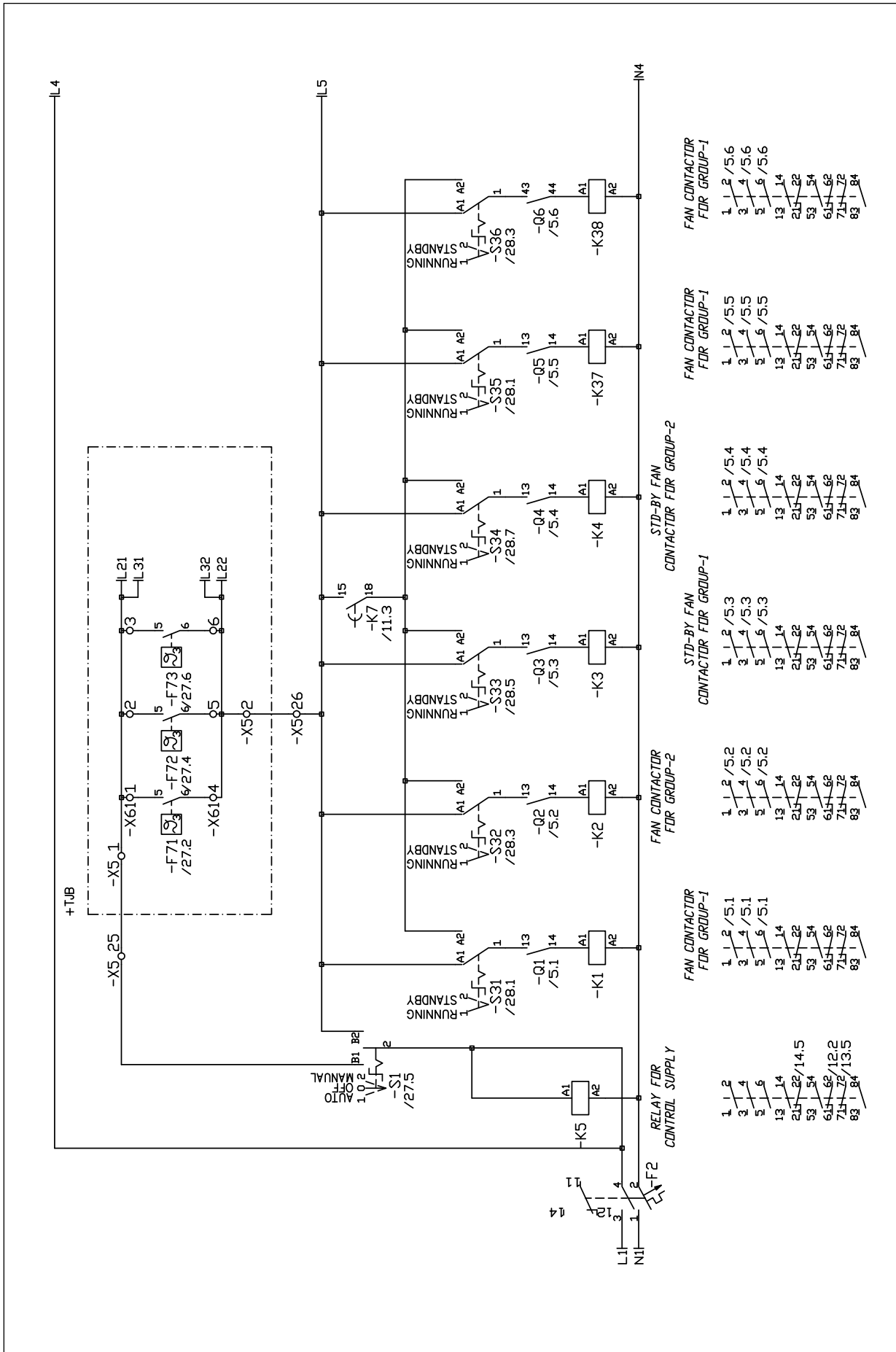


Fig. 3.3 (d): Typical Control Circuit for Fan Group – 1

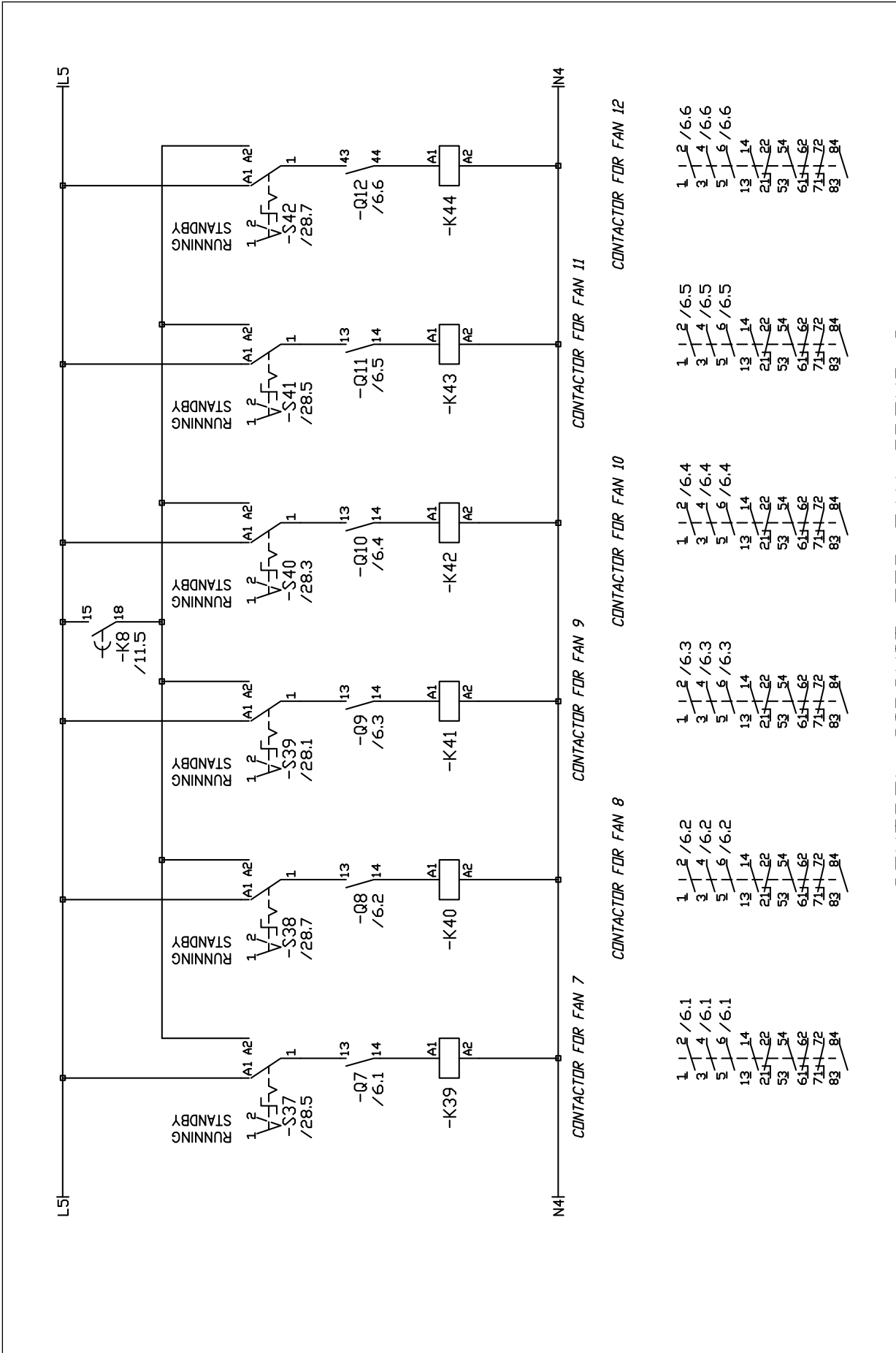


Fig. 3.3 (e): Typical Control Circuit for Fan Group – 2

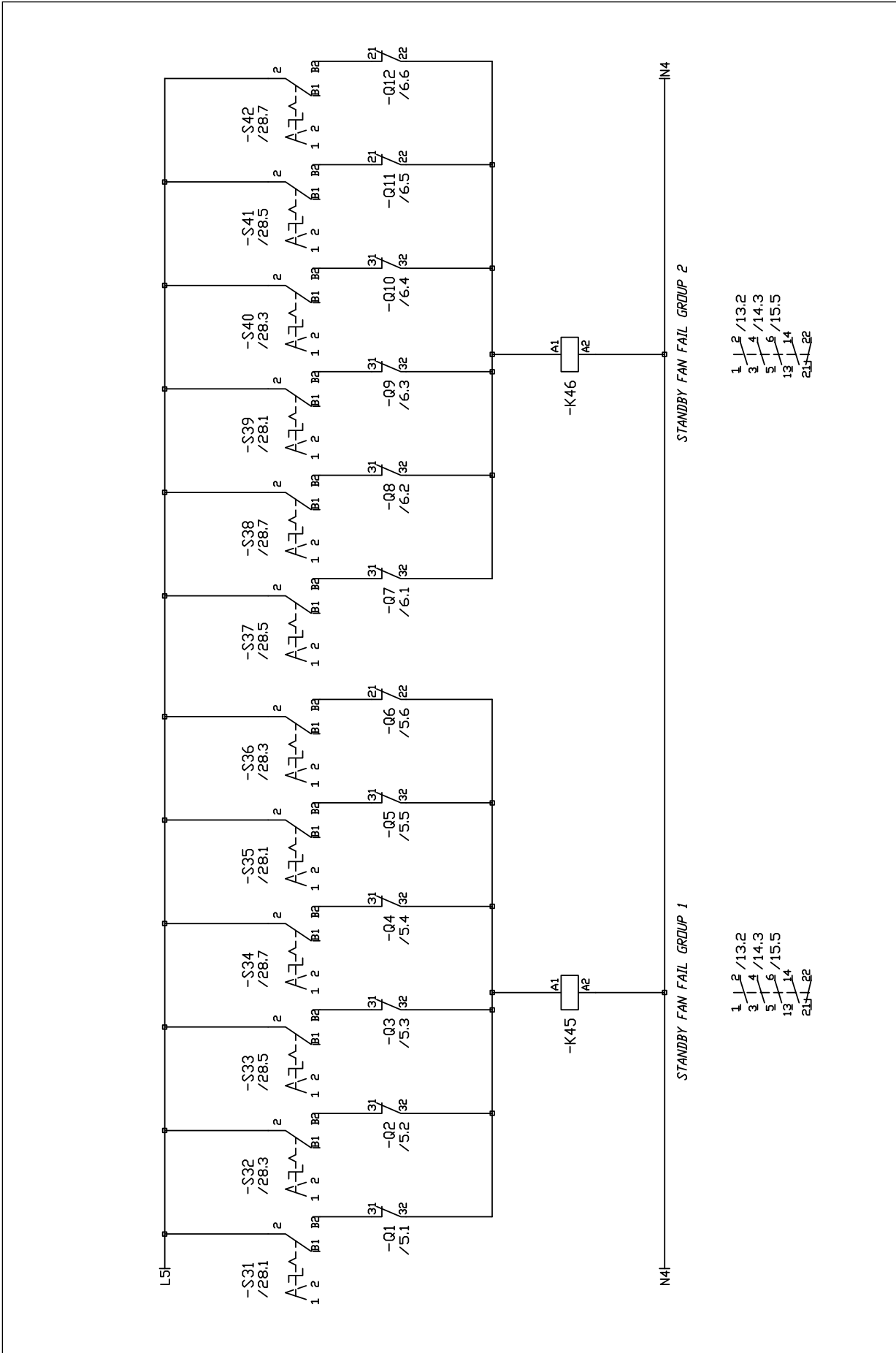


Fig. 3.3 (f): Typical Control Circuit for Fan Group 1 & 2

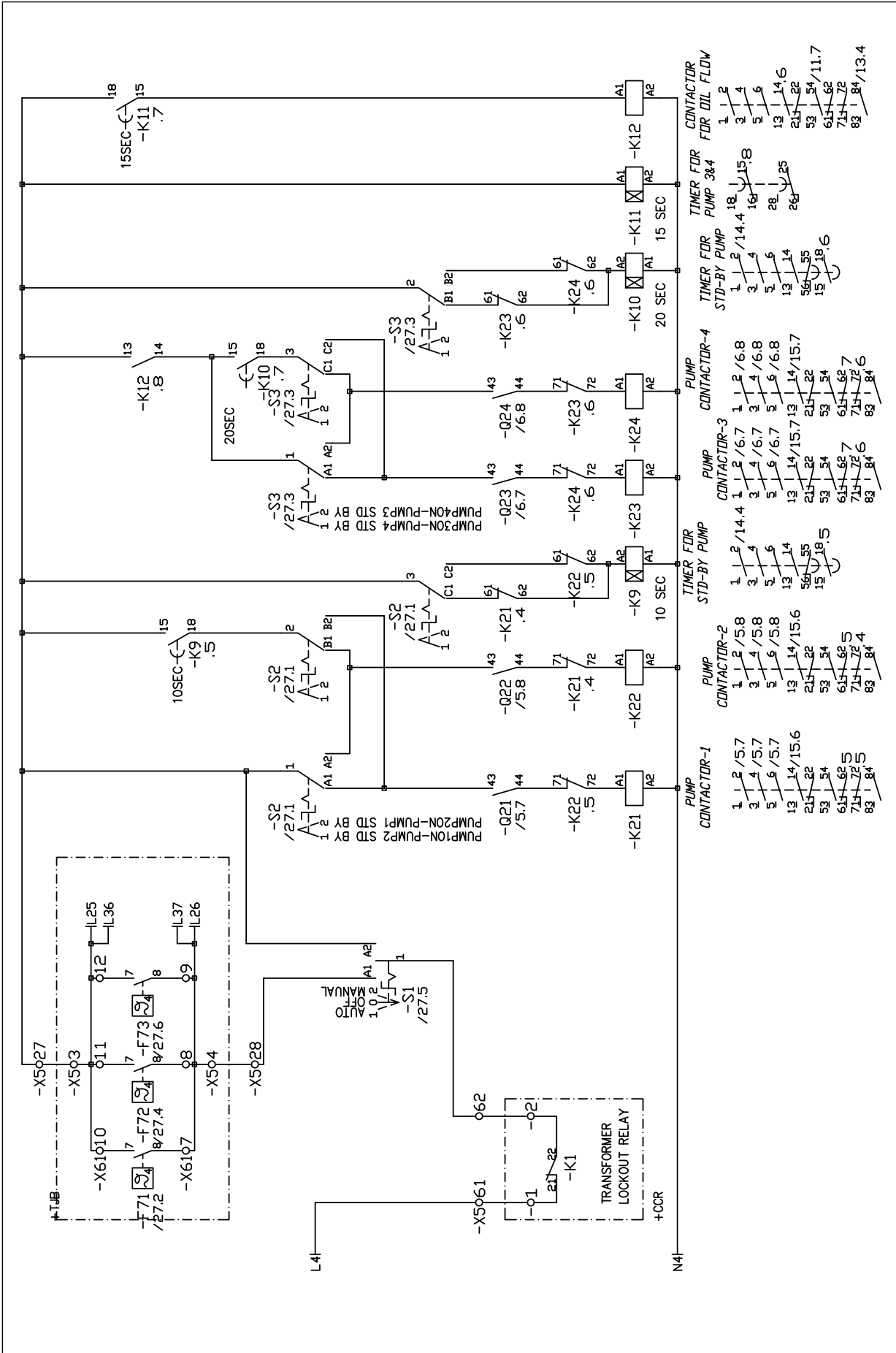


Fig. 3.3 (g): Typical Control Circuit for Pumps

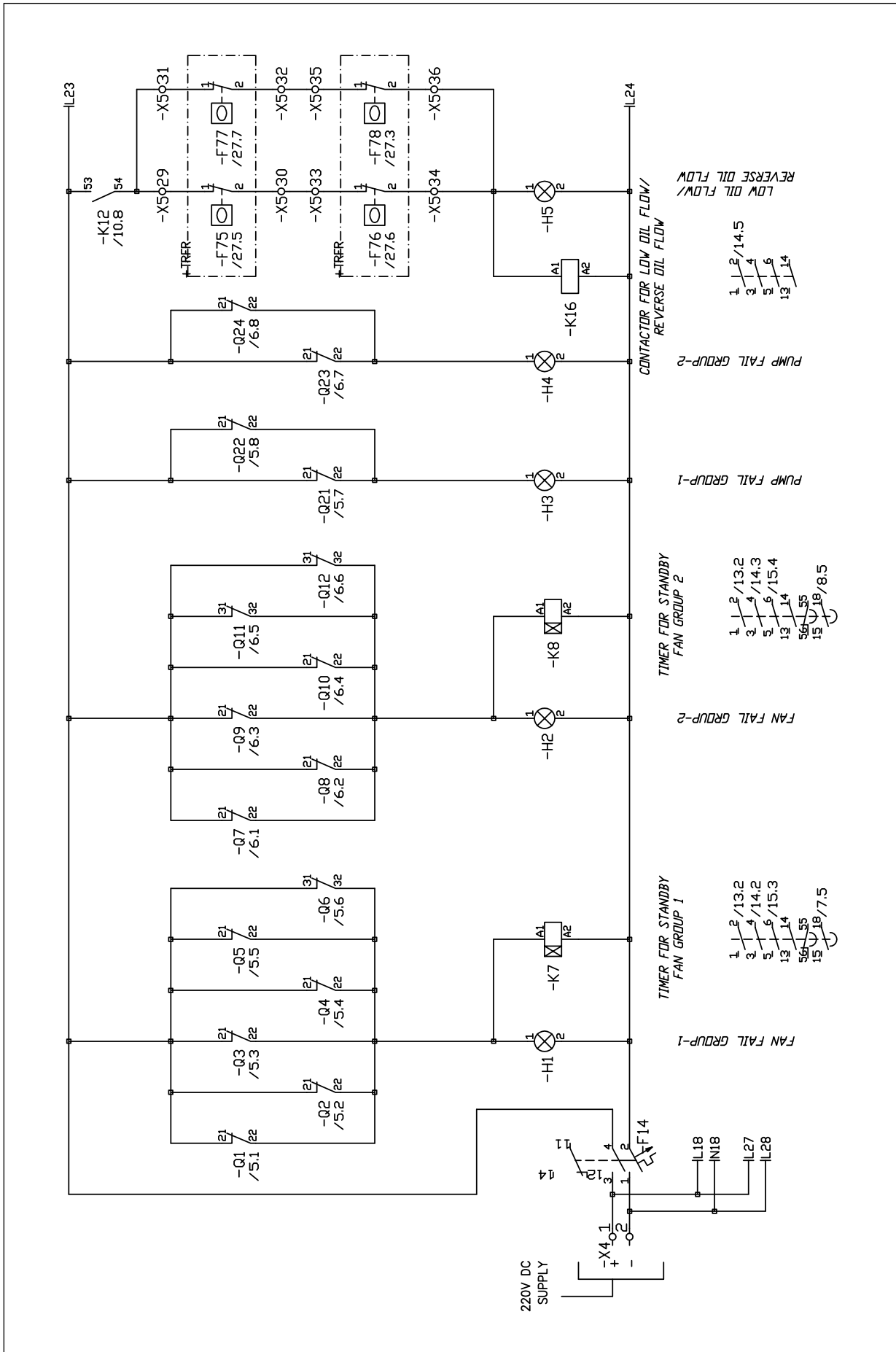


Fig. 3.3 (h): Typical Indication Signals

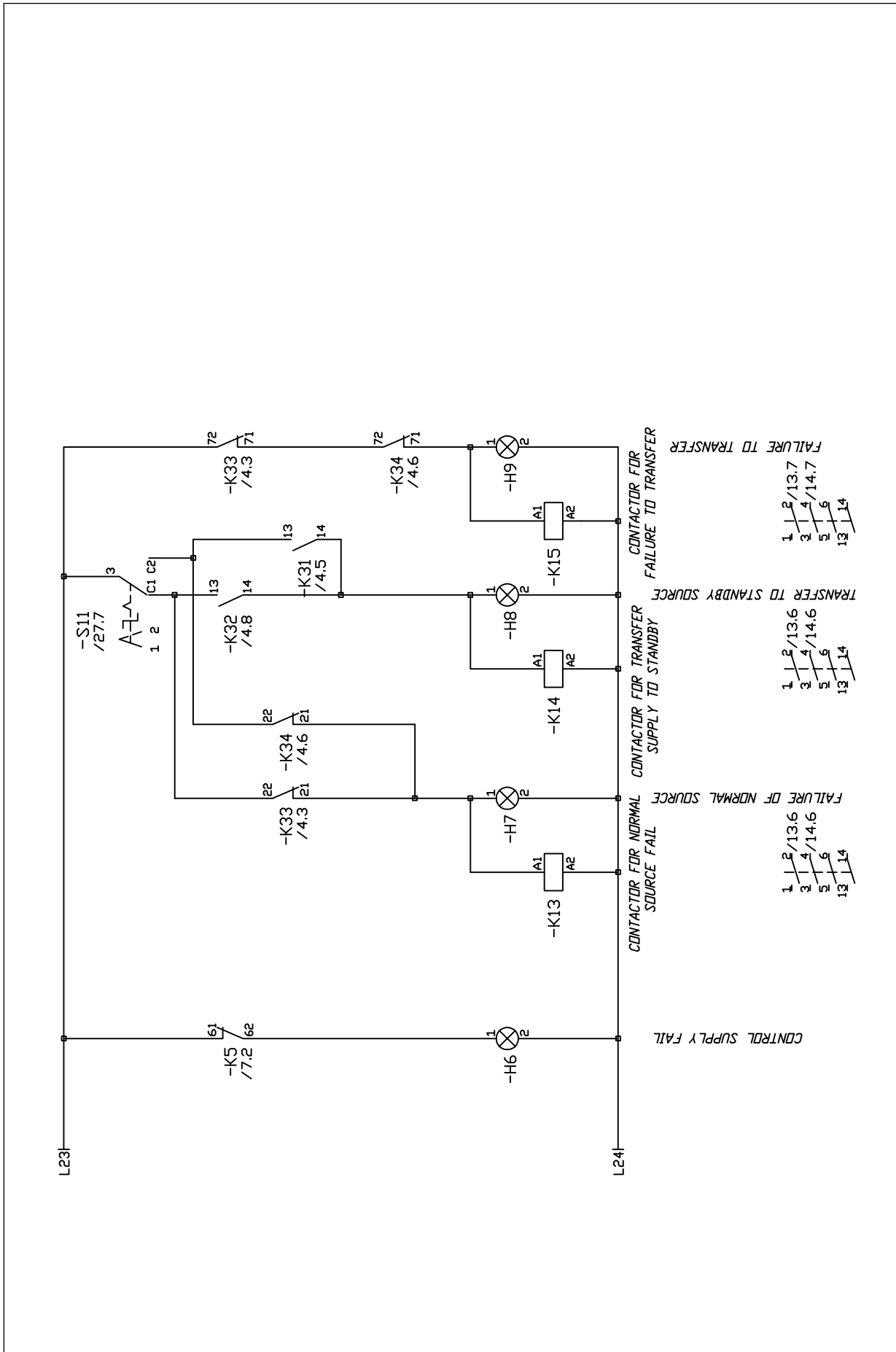


Fig. 3.3 (i): Typical Indication Signals

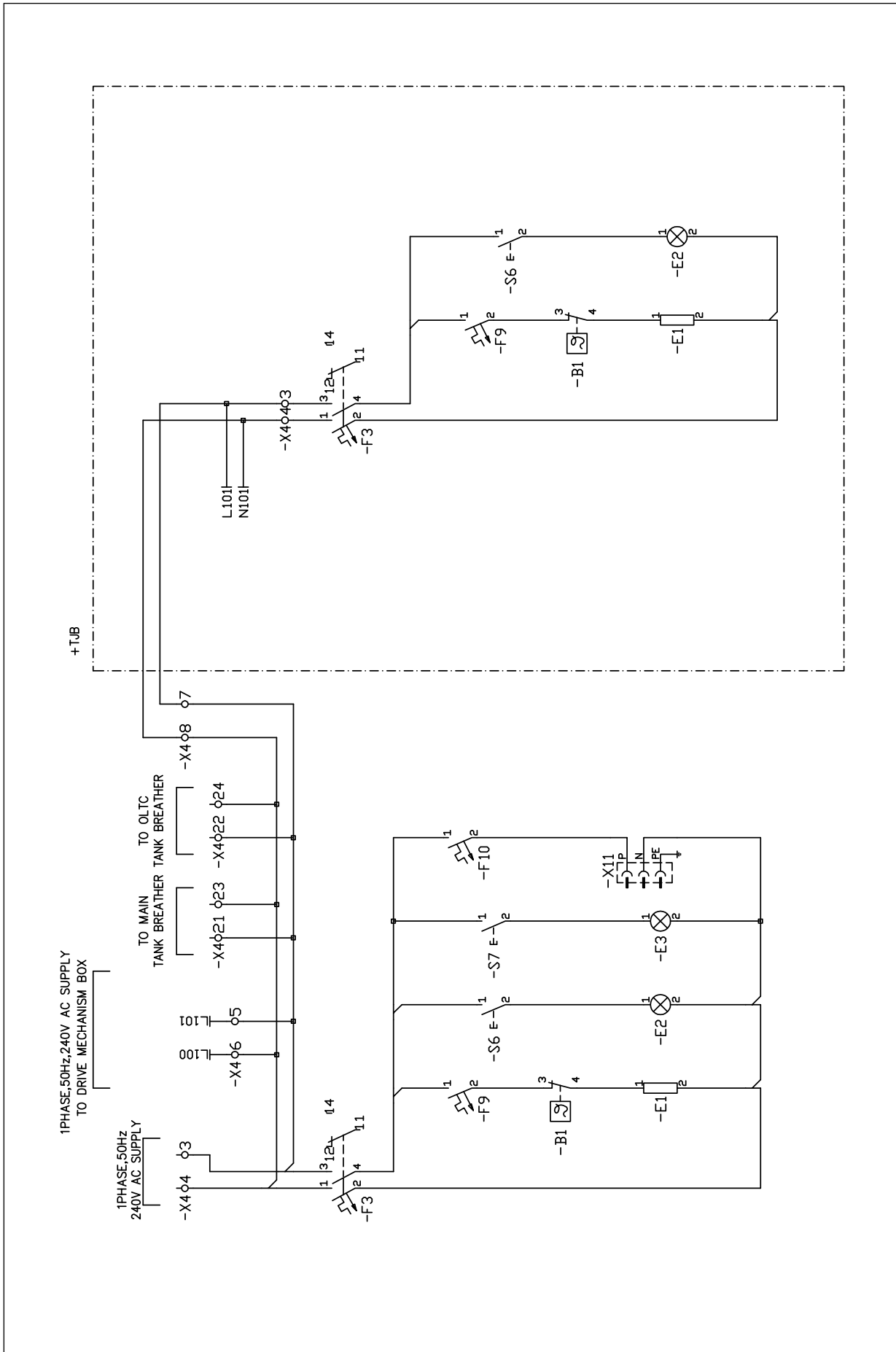


Fig. 3.3 (j): Typical Heater and Lighting Circuit

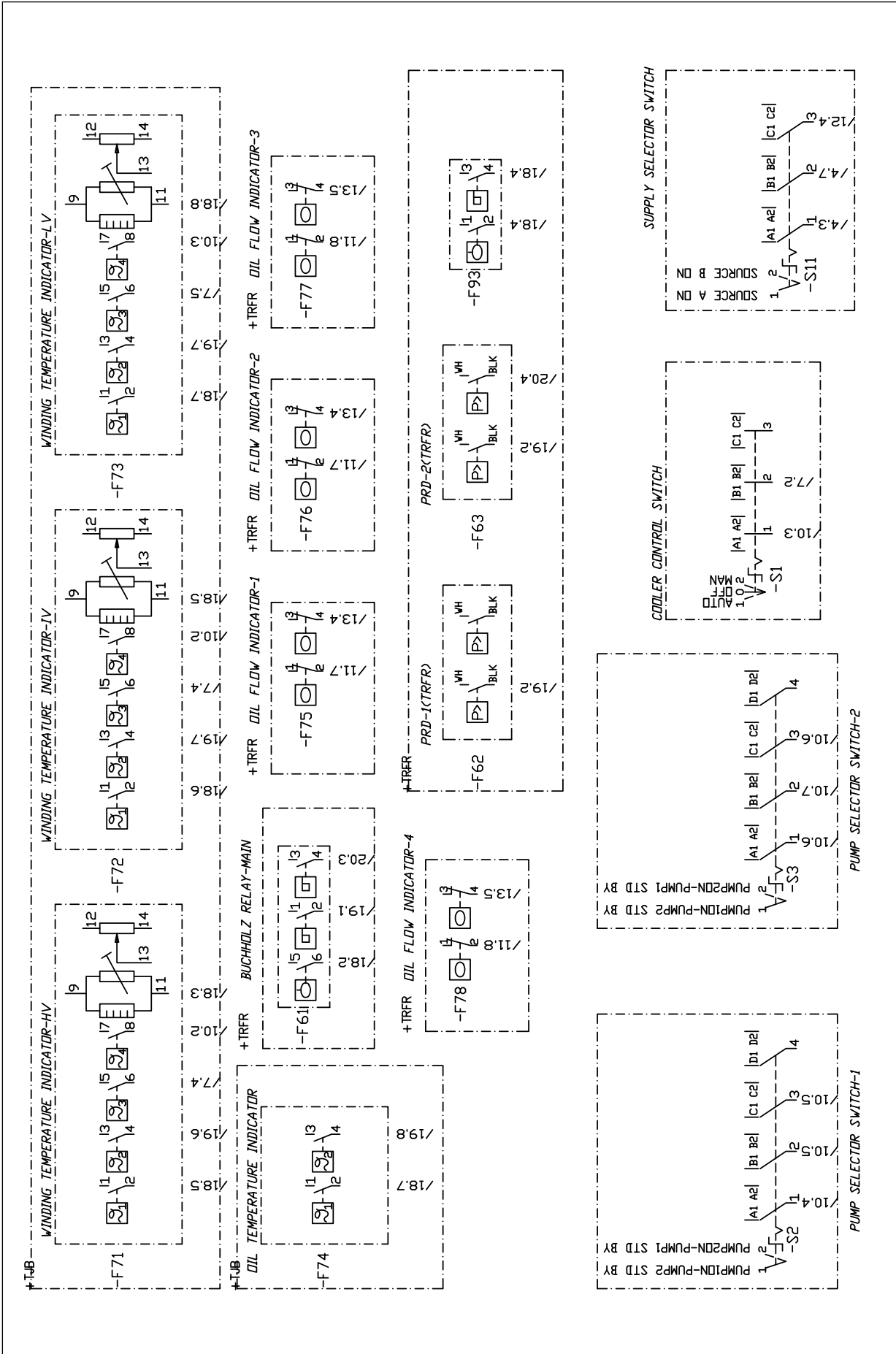


Fig. 3.3 (k): Typical Device Configuration

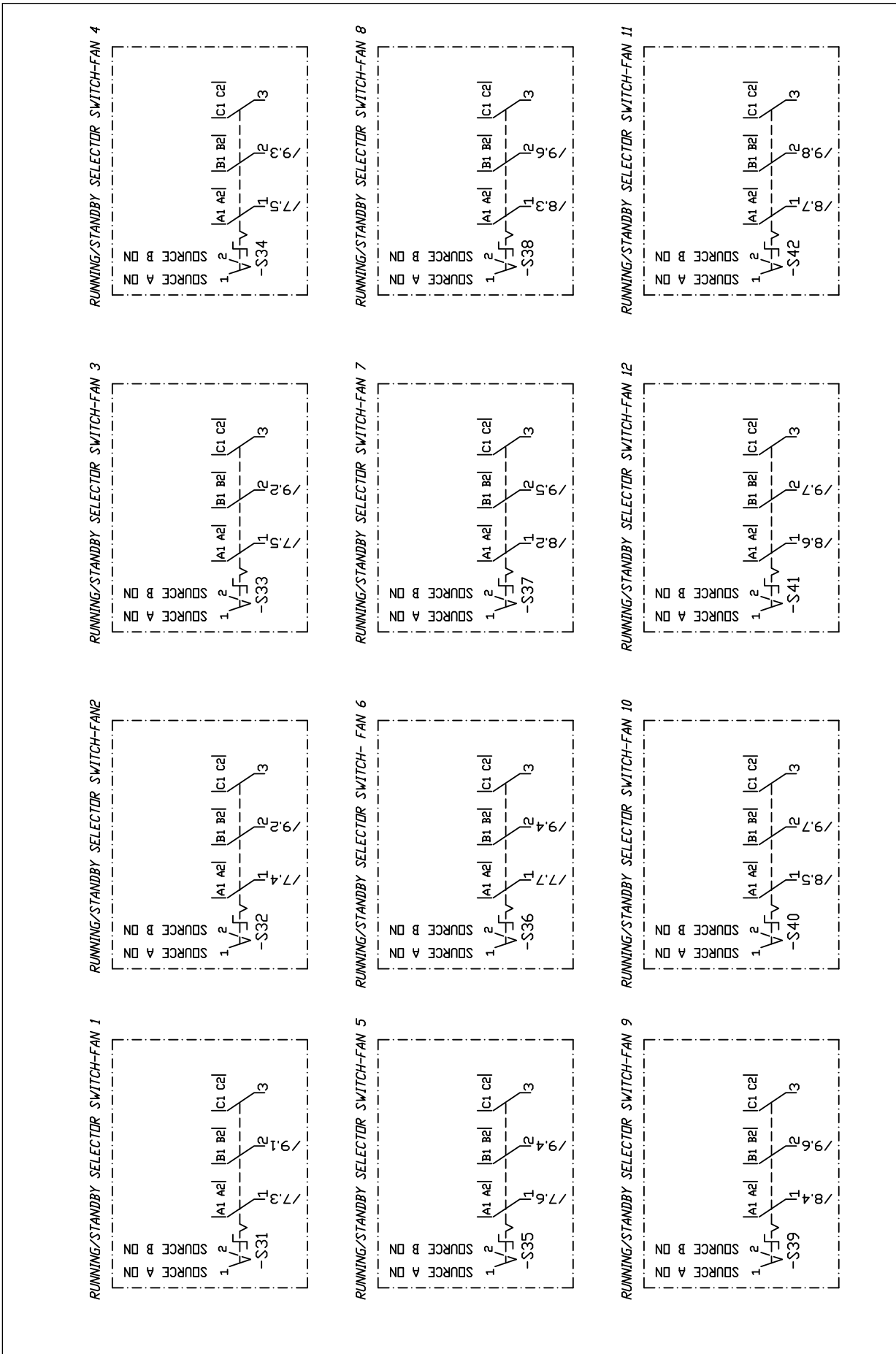


Fig. 3.3 (I): Typical Device Configuration

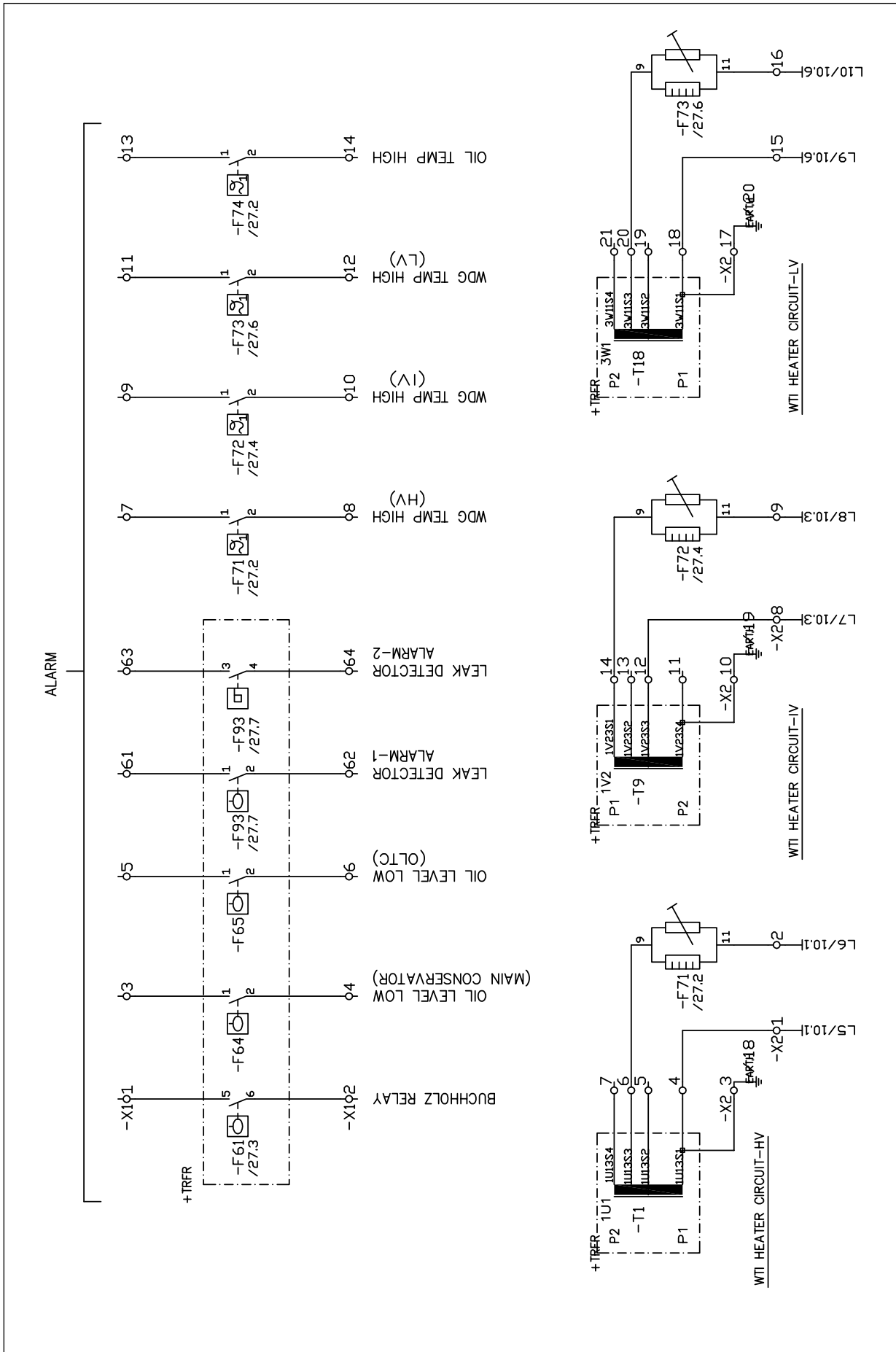


Fig. 3.4 (a): Typical Alarm and WTI Circuit

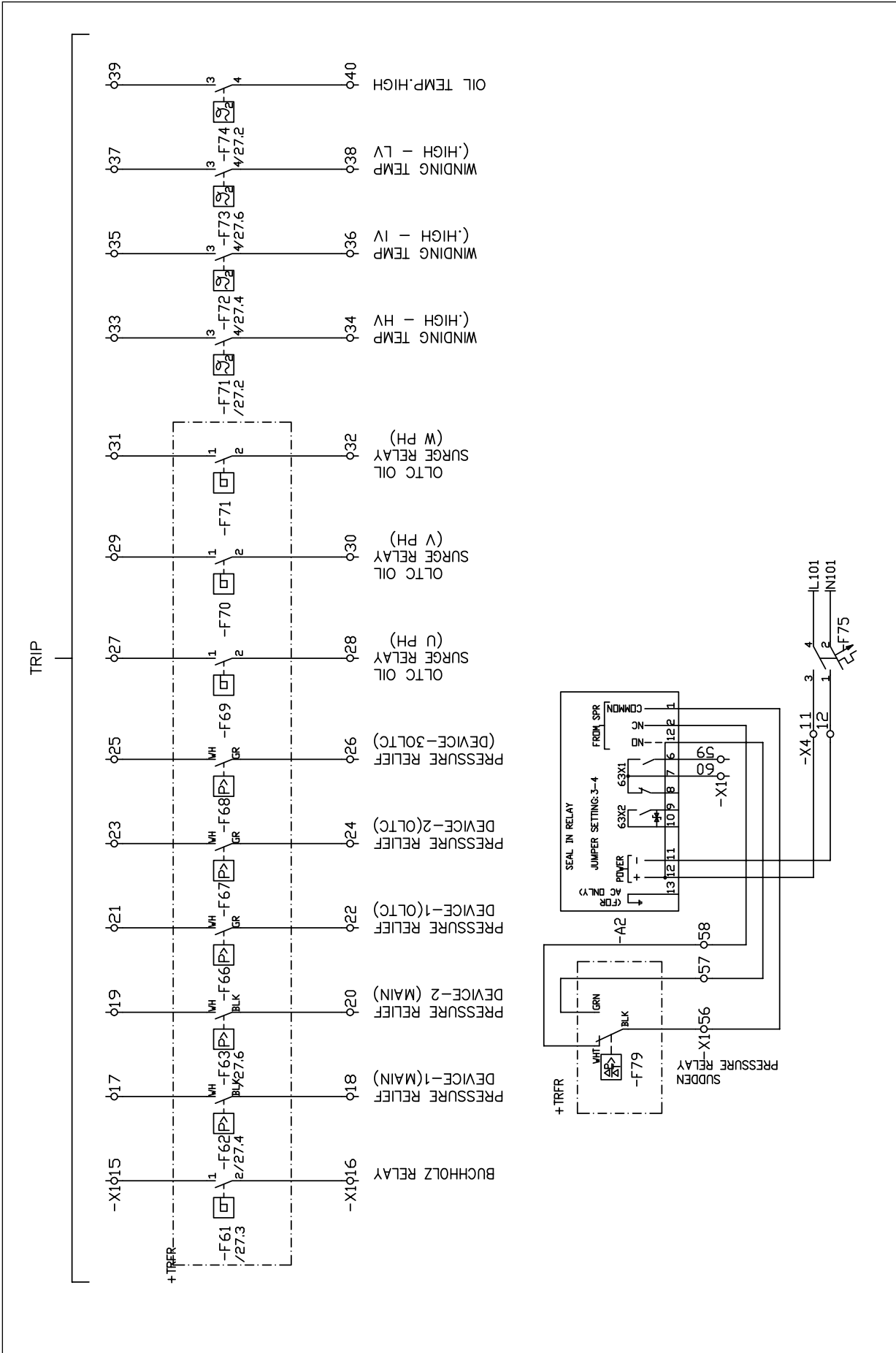


Fig. 3.4 (b): Typical Trip Circuit

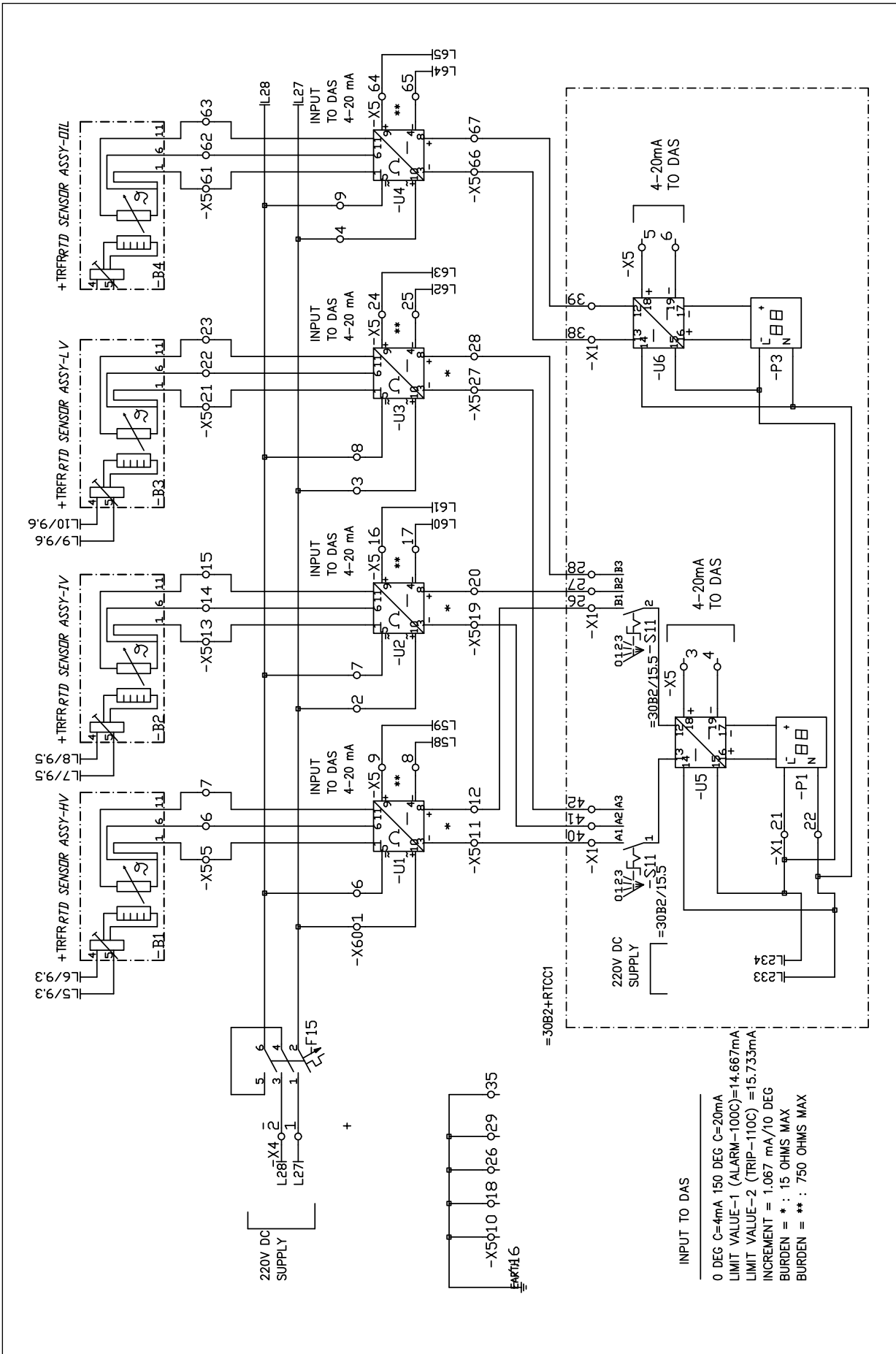
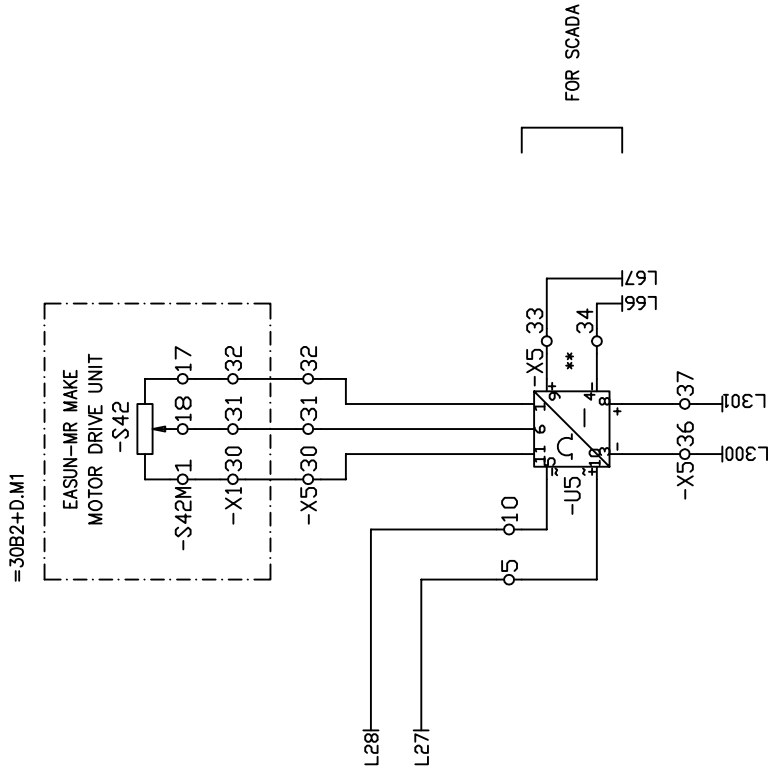


Fig. 3.4 (c): Typical Winding and Oil Temperature Signals



INPUT TO DAS

0 DEG C=4mA 150 DEG C=20mA
 INCREMENT = 1.067 mA/10 DEG
 BURDEN = * : 15 OHMS MAX
 BURDEN = ** : 750 OHMS MAX
 TAP NO. 1=4mA TAP NO.17=20mA

Fig. 3.4 (d): Typical Tap Position Signals

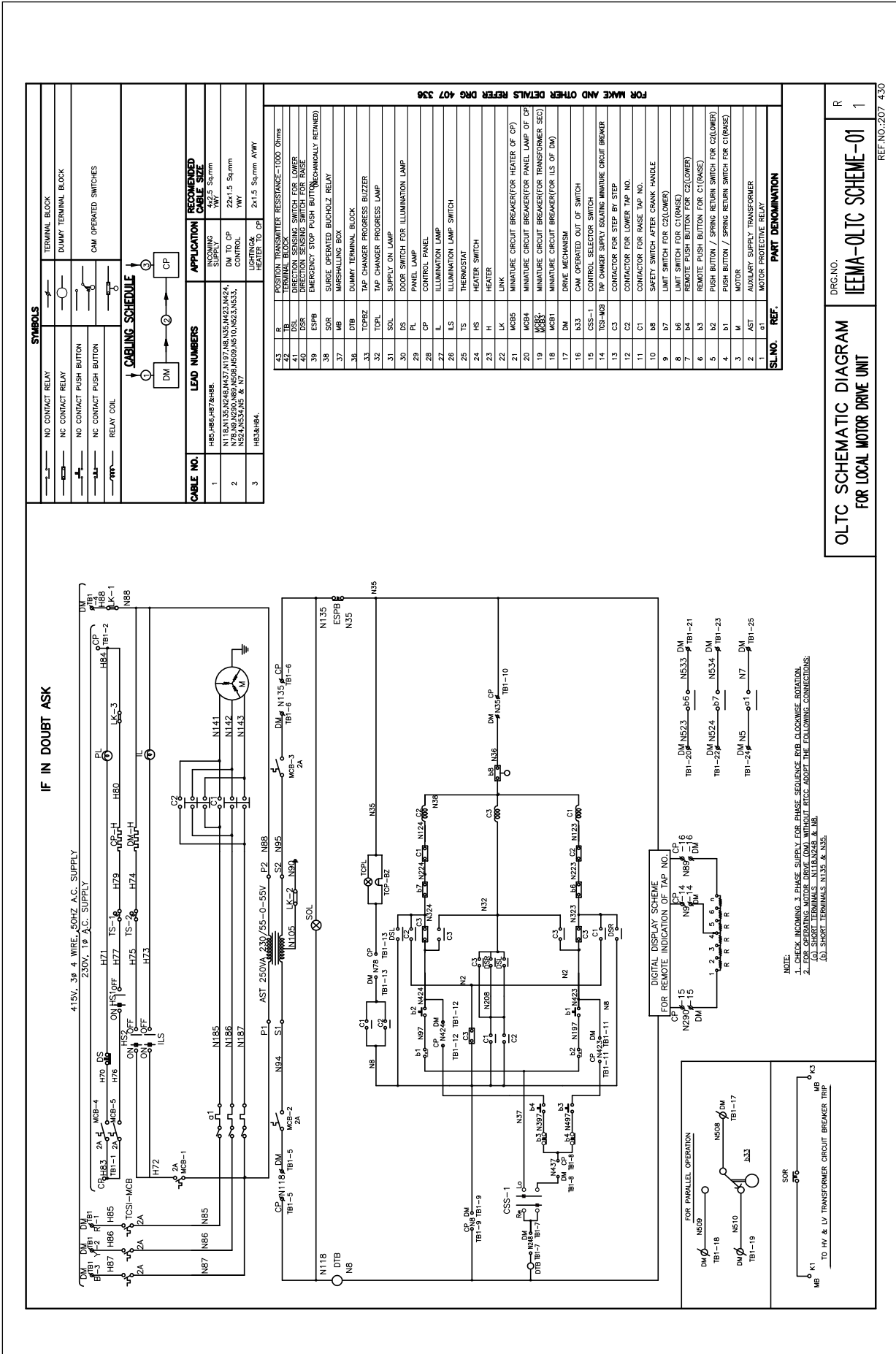


Fig. 3.5 : Typical OLTC Schematic Diagram