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सत्यमेव जयते

भारत सरकार - रेल मंत्रालय
अनुसंधान अभिकल्प और मानक संगठन
लखनऊ - 226 011

Government of India-Ministry of Railways
Research Designs & Standards Organisation
Lucknow - 226 011

No. EL/7.2.2

Date 15.12.2011

Chief Electrical Engineer

- Eastern Railway, Fairlie Place, Kolkata - 700 001
- Northern Railway, Baroda House, New Delhi-110 001
- Central Railway, Parcel office, CST, Mumbai CST - 400 001
- Northeast Frontier Railway, Maligaon, Guwahati -781 001
- North Eastern Railway, Gorakhpur -273 001
- South Central Railway, Nilayam, Secunderabad - 500 371
- Southern Railway, Park Town, Chennai -600 003
- South Eastern Railway, Garden Reach, Kolkata -700 043
- Western Railway, Churchgate, Mumbai - 400 020
- North Central Railway, Subedarganj, Allahabad-211033
- Western Central Railway, Jabalpur-482 001
- East Central Railway, Dighi, Distt- Vashali, Hajipur, Bihar-844 101
- North Western Railway, Jaipur 302006
- South Western Railway, New Zonal Head Quarters Office, 1st Floor, West Block, Gadag Road, Hubli-580 020 (Karnataka)
- South East Central Railway, Bilaspur-495004
- East Coast Railway, Bhuvneshwar Orrisa-751 016
- Konkan Railway, Belapur Bhawan, Sector-11, Belapur, Mumbai - 400 614
- Integral Coach Factory, Chennai.-600038
- Rail Coach Factory, Hussainpur, Kapurthala-144 602

मुख्य विद्युत इंजीनियर

- पूर्व रेलवे फेयरली प्लेस, कोलकाता-700001
- उत्तर रेलवे, बड़ौदा हाउस, नई दिल्ली-11000
- मध्य, रेलवे मुंबई सीएसटी-400 001
- पूर्वोत्तर सीमान्त रेलवे, मालीगांव, गुवाहाटी-781001
- पूर्वोत्तर रेलवे, गोरखपुर-273001
- दक्षिण मध्य रेलवे, रेल निलयम सिकंदराबाद-500371
- दक्षिण रेलवे पार्क टाउन, चेन्नई-600003
- दक्षिण पूर्व रेलवे गार्डेन रीच, कोलकाता-700043
- पश्चिम रेलवे चर्चगेट, मुंबई-400020
- उत्तर मध्य रेलवे, सुबेदारगंज, इलाहाबाद-211033
- पश्चिम मध्य रेलवे, जबलपुर-482001
- पूर्व मध्य रेलवे, हाजीपुर-844101
- उत्तर पश्चिम रेलवे, जयपुर-302006
- दक्षिण पश्चिमी रेलवे, न्यू जोनल मुख्यालय कार्यालय, प्रथम तल चश्चिम ब्लाक गदाग रोड, हुबली-580 020 कर्नाटक
- दक्षिण पूर्व मध्य रेल, बिलासपुर-495 004
- पूर्वान्त रेलवे, भुवनेश्वर उड़ीसा -751 016
- कोणकन रेलवे, बेलापुर भवन, सेक्टर-11, बेलापुर मुम्बई-400 614
- सवारी डिब्बा कारखाना, चेन्नई-600 038
- रेल डिब्बा कारखाना, हुसैनपुर, कपूरथला -144 602

Sub : Revised specification No. RDSO/PE/SPEC/AC/0061-2005 (Rev.1) for Roof Mounted AC Package Unit for LHB variant AC coaches.

Ref : Old Item No. 7 of 24th MSG meeting.

Reliability related issues of LHB variant RMPU were discussed during 23rd & 24th MSG meeting. A committee comprising Director/RDSO, Dy.CEE/D/RCF & Sr. DEE/Coaching/New Delhi was constituted by Railway Board to study various reliability related issues of electrical equipments of LHB coaches. Report prepared by the committee was discussed during 24th MSG meeting and the recommendations have been accepted by Railway Board.

The specification of Roof Mounted AC Package Unit for LHB variant AC coaches has now been revised based on the recommendations of the committee and feedback given by the various Railways. The draft specification was also circulated to Railways vide letter of even number dated 24.3.2011 & 9.5.2011 to all the Railways as well as RDSO approved sources. It was also uploaded on RDSO website. After incorporating the suggestions received from Railways and manufacturers, the revised specification has now been finalised.

Some of the major changes in the revised specification are as under :-

1. Only R-407C refrigerant is permitted.
2. Separate specification for microprocessor controller has been made and the paras related to controller have been deleted.
3. Expansion valve is to be provided in place of capillary tube.

4. Condenser and blower motors of only RDSO approved make as per RDSO specification to be provided.
5. Canvas duct shall confirm to RDSO specification and to be procured from RDSO approved sources.
6. Servo motor (Belimo) for fresh air control has been removed and in its place a fixed type damper as used in conventional RMPU is provided.
7. Hot gas bypass arrangement and other solenoid valve have been removed.
8. Direct mounted HP/LP pressure cut out has been provided in place of capillary type cut out.
9. Logic for controller and regulation of system has been described.
10. Connections with microprocessor controller have been standardised to ensure interchangeability..
11. List of sources in bill of material has been expanded.

Firms have been given six months time to comply to the revised requirements of the specification. It is expected that there will be a reduction in price of LHB RMPU upon implementation of this specification.

(Prafulla Chandra)
DSE(TL-AC System Design)
for Director General/PS & EMU

DA :As above

Copy to :

सचिव/विद्युत/जी
रेलवे बोर्ड, रेल भवन
रेल मंत्रालय
नई दिल्ली- 110 001

ध्यानकर्षण श्री जयदीप, डीईइ (जी)
for information please.

(Prafulla Chandra)
DSE(TL-AC System Design)
for Director General/PS & EMU

DA :As above

Copy to :

1. मेसर्स सिडवाल रेफ्रिजेशन इन्डस्ट्रिज इण्डिया लिमिटेड, 108-ए, मदनगीर, नई दिल्ली-110062
2. मेसर्स इन्टेक कार्पोरेशन, मेन थापल इन्डस्ट्रियल एरिया काला अम्ब, जिला-सिरमौर
3. मेसर्स लॉयड इलेक्ट्रिक एण्ड इंजीनियरिंग लि0, ए-146 (B & C), RIICO इंडस्ट्रियल एरिया, मिवाड़ी जिला अलवर, राजस्थान- 301 019
4. मेसर्स अमित इंजीनियर्स, बी-61 इ0 एरिया, फेस-VII, एस.ए. एस नगर मोहाली, पंजाब-160055
5. मेसर्स फैंडर्स लॉयड कार्पोरेशन लि0, सी-4, फेस-II, नोएडा-201 305
6. मेसर्स स्टेसलिट लि0, पार्क प्लाजा :छद्म 71, पार्क स्ट्रीट, कोलकाता-700016
7. मेसर्स अम्बर इण्टरप्राइसेस (इण्डिया) प्रा0 लि0, सी-1, फेस-II फोकल प्वाइंट, राजपुरा-140 401 पंजाब
8. मेसर्स एस0एस0के0 इंजीनियरिंग कं0 लिमिटेड, फैक्टरी एरिया, पी.ओ. बॉक्स-8, कपूरथला-144 601
9. मेसर्स दौलत राम इन्डस्ट्रिज 141, सेक्टर-xx डी सी इन्टीग्रेटेड इन्डस्ट्रियल एरिया, रानीपुर हरिद्वार-249403
10. मेसर्स दौलतराम इंजीनियरिंग सर्विसेस प्रा0 लि0, 10/2, नेशनल हाईवे-12, सिमराये, नियर मन्डीद्वीप जिला राएसेन -464 993

You are advised to submit compliance to the revised specification within six months from the date of issue of this letter. Non compliance of the specification within the stipulated period may lead to down-gradation/delisting as per RDSO's procedure.

(Prafulla Chandra)
DSE(TL-AC System Design)



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भारत सरकार

रेल मंत्रालय

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

अनुसंधान अभिकल्प एवं मानक संगठन

रेल मंत्रालय

RESEARCH DESIGNS AND STANDARDS ORGANISATION
MINISTRY OF RAILWAYS

एल. एच. बी. वेरिएन्ट ए सी डिब्बो के लिये रूफ माउन्टेड ए सी पैकेज यूनिट की विशिष्टि

SPECIFICATION FOR ROOF MOUNTED AC PACKAGE UNIT
FOR LHB VARIANT AC COACHES

आरडीएसओ/पीई/स्पेक/एसी/0061-2005 (रिवी.-1)

RDSO/PE/SPEC/AC/0061- 2005 - (REV. 1)

S. No	Date of amendment	Revision/ Amendment	Reason
1	Dec. 2011	Rev.1	Specification of microprocessor controller separated, Servo drive, solenoid valve, capillary tubes, hot gas bypass system removed and other improved features incorporated.

अनुमोदित

APPROVED

12.12.11,

कार्यकारी निदेशक/पी एस एण्ड ई एम यू

ED/PS & EMU

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SPECIFICATION FOR ROOF MOUNTED AC PACKAGE UNIT FOR LHB VARIANT AC COACHES

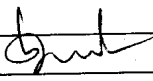
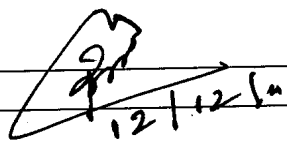
SCOPE

- 1.1 This specification lays down the technical requirements of design, manufacture, supply & testing of the Roof Mounted A/C Package unit for LHB Variants of AC coaches for Indian Railways. The LHB design of coaches having two RMPUs is controlled by one Microprocessor Controller unit. The microprocessor controller for RMPU shall be as per RDSO specification No. RDSO/PE/SPEC/AC/0139 – (Rev.1)-2009. This specification supersedes earlier RDSO specification No. RDSO/PE/SPEC/AC/0061 (Rev.0)-2005 with amendment No. 1 & 2. The existing approved vendor of RDSO for this item shall ensure compliance to this specification within six months from the date of issue.

2.0 SCOPE OF SUPPLY

- 2.1 The scope of supply for roof mounted AC package unit for LHB variants of AC coaches shall include the followings unless otherwise stipulated in the tender: -

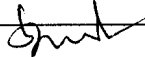
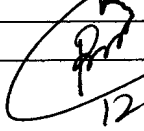
S.No	Description	No.
1.	Type –I (For all coaches except generator car)	
	I) AC package unit complete including resilient mounting, flexible duct (bellows), connectors complete with plugs and sockets for Electrical connection, Switch Panel and accessories as per Clause 2.2	1 no.
	II) Microprocessor Controller Unit- RDSO specification. No RDSO/PE/SPEC/AC/ 0139- (Rev.1)-2009	1 no. for every two Package unit
2.	Type –II (For generator car)	
	I) AC package unit complete including resilient mounting, flexible duct (bellows), connectors complete with plugs and sockets for Electrical connection, Switch Panel and accessories as per Clause 2.2.	1 no.
	II) Microprocessor Controller Unit- RDSO specification. No RDSO/PE/SPEC/AC/ 0139- (Rev. 1)-2009	1 no. for one package unit

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2.2 Each package unit shall have the following:

S. No	Item	Quantity per RMPU
1.	Hermetically sealed scroll compressor	2
2.	Condenser coil unit	2
3.	Condenser motor unit	2
4.	Condenser fan having FRP blades	2
5.	Evaporator coil unit	2
6.	Blower motor unit	1
7.	Blower fans	2
8.	Filter dryer	2
9.	Cartridge pressure control (HP & LP) i.e. Direct mounted Pressure switches (HP setting 425±15 psig, LP setting 30±5 psig)	2 for HP+2 for LP
10.	Pressure transmitter/sensor/transducer 0-10 bar (IP65)	2
11.	Pressure transmitter/sensor/transducer 0-40 bar (IP65)	2
12.	Fresh air intake cassette	2
13.	Mixed/return air filter as per RDSO drg. No. RDSO/PE/SK/AC/0073-2004 (Rev. 1)	2
14.	Fresh air filters per. drg no. RDSO/PE/SK/AC/0074-2004 (Rev 1)	2
15.	Over Heat protection switch for heater	1
16.	ESTI cartridge +130°C	1
17.	Anti vibration mounting pads	4
16.	NTC temperature sensor	3
17.	Sight glass	2
20	Thermostatic expansion valve suitable for automobile application	2
21.	Hygrostat (30-100% RH)	1
22.	Three phase stainless steel heater elements bank without fins each not less than 6 KW capacity.	1 Set of 6.0 kW
23.	Stainless steel drip trays complete with arrangement for drainage of condensate water.	2
24.	Compressor anti-vibration mountings	as reqd.
25.	Condenser motor anti-vibration mounting	as reqd.
26.	Liquid receiver	2
27.	Accumulator (optional)	2
28.	Switch panel as per RDSO drawing No. RDSO/PE/SK/AC/0125-2009 (Rev.1)	1
29.	Connectors (Male/Female) along with accessories as indicated below:	2 for power & 2 for control supply
	Protection hose VCSG29B;NW29 of M/s. PMA or	10 Mtrs

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	equivalent as approved by RDSO.	
	Connecting fitting NVAV-P299G; Pg. 29 of M/s. PMA or equivalent as approved by RDSO.	4 Nos.
	Elbow screw joint NVWV- P299G; Pg 29 of M/s. PMA or equivalent approved by RDSO.	4 Nos.
	Nut DIN46320;Pg29 or equivalent as approved by RDSO.	8 Nos.
	Connection fitting BFIO-P229G; Pg29 of M/s. PMA or equivalent as approved by RDSO.	4 Nos. per package unit
Note: The connections of the above attachment shall be IP 65.		

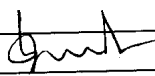

Note : Make of the various components/equipment shall be as per Annexure – I.
Prior approval of RDSO should be obtained for any change.

2.3 Switch panel

The control panel shall be integral part of the switchboard cabinet to RCF specification no. EDTS073, which is not in the scope of this specification. Switch panel as per RDSO Drawing No. RDSO/PE/SK/AC/0125 -2009 (Rev 1), is only to be supplied loose.

3.0 POWER SUPPLY

- 3.1 The Roof Mounted A/C package Unit shall be suitable to work from $415V \pm 5\%$, AC, 3 phase, $50 \text{ Hz} \pm 3\%$, sinusoidal/PWM power supply obtained from DG Sets/converter installed in generator car on EOG type AC coaches or 25 KVA inverter (with ripple contents up to 15%) on SG type AC coaches. The controller shall work on $110 \text{ V DC/AC} \pm 30\%$.
- 3.2 All control and power supply connectivity within AC package and incoming/outgoing cable shall be ensured through couplers (Cage clamp type) as per Annexure-I.
- 3.3 Power cables and control cables shall run in separate conduits. Halogen free non-metallic conduit as per IEC 61386 (part I) or RDSO specification No. RDSO/PE/SPEC/AC/0138 (Rev.0)-2009 made of polyamide material which meets the UL94 V0 grade fire property shall only be used.
- 3.4 The AC package unit shall be installed by the purchaser. However, initially, the supplier shall associate in testing, commissioning of the module and interface with the microprocessor controller and switch board cabinet etc. Railway will provide only 415 V, AC, 50 Hz supply.
- 3.5 Power cables shall be of e-beam thin walled cable as per latest RDSO specification No. RDSO/SPEC/ELC/0019-(Rev.2) with latest

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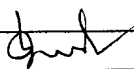
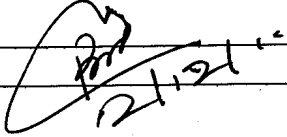
amendment/revision, whereas the control cables shall be of PTFE type as per JSS 50134. The power cable shall be of RDSO approved make.

- 3.6 The size of the cables used shall be as per RDSO drawing No. RDSO/PE/SK/AC/0072-2004 (Rev.'1')
- 3.7 The equipments working above 110 V supply shall be provided with danger plate as per IS: 2551.
- 3.8 Earthing symbol plate shall be provided at all locations.

4.0 SERVICE CONDITIONS

- 4.1 The equipment shall be sturdy and suitable for the following service conditions, which are normally encountered during service.

Ambient	- 4 to 57 deg C
Average ambient	35 deg. C
Max. temp. inside coach under sun	70 deg. C
Train speed	200 Km/h
Relative Humidity	Upto 100%
Altitude	Max 1200 m above sea level
Atmosphere	Extremely dusty and desert weather and desert terrain in certain areas. The dust contents in the air may reach as high value as 1.6 mg/cubic meter.
Annual rain fall	Very heavy in certain areas: between 1750 to 6250 mm.
Coastal area	The equipment shall be designed to work in humid salt laden and corrosive atmosphere. The maximum values of the condition shall be as under : Maximum pH value 8.5 Sulphate 7 mg/litre Max. concentration 6 mg/litre of chlorine Max. conductivity 130 micro siemens/CM
Shocks and Vibration	The RMPU shall withstand satisfactorily vibrations and shocks normally encountered in service as indicated below: a) Max. vertical acceleration - 3.0 g b) Max. laterall acceleration - 3.0 g c) Max. longitudinal acceleration - 3.0 g (‘g’ being the value of acceleration due to gravity)

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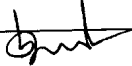
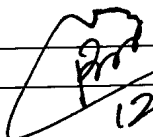
5.0 GOVERNING SPECIFICATIONS

No. of standard	Description
DIN 45635	Noise level measurement
UIC: 553 OR	Ventilation Heating and Air conditioning
UIC: 553-1	Air conditioning system in coaches, type test
UIC: 564-2	Measures in passengers carrying Railway vehicle or associated vehicle used on International service
IEC 60529	Degree of protection provided by enclosures (IP Code)
IEC 60571	Rules for electronic equipment on rail vehicles
IEC 1000-4-4	Electromagnetic compatibility (EMC)-Pt. 4, Testing and measurement technique-section 4, Electrical test transient/burst immunity test.
IEC 61373	Railway application-Rolling stock equipment-Shock and vibration test
IEC 61386 - I	Conduit system for cable management, Particular requirement
IS: 659	Safety code for air-conditioning
IS: 2551	Danger Notice Plates.
IS: 5493	Dimensions for wrought Copper and Copper alloy tubes
IS:6911	Stainless steel plates, sheets and strips
IS: 10773	Wrought Copper tubes for refrigeration and air conditioning purpose.
IS:13947, Pt. 1	Specification for low voltage switchgear & control gear – Pt. 1, General requirements
RDSO/PE/SPEC/AC/0139 – 2009 - (Rev. 1)	Specification of microprocessor controller of roof mounted ac package unit for LHB and double decker AC coaches.
RDSO/PE/SPEC/AC/0136 – 2009 - (Rev. 0)	Specification for cotton canvas for use in supply and return air duct for air-conditioned coaches
RDSO/PE/SPEC/AC/0089 -2008 (Rev.0) with latest amendment	Three phase, induction motors for Roof Mounted AC Package Unit.

Note: Latest version of the above specifications/standards shall be applicable and manufacturers are supposed to have these standards for their reference.

6.0 SUPPLIER'S RESPONSIBILITY

- 6.1 The Roof Mounted A/C Package Unit shall be suitable for rugged service conditions normally to be met within Railway Rolling Stock, where coaches are expected to run upto a maximum speed of 160 kmph in varying climatic conditions existing throughout India.

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- 6.2 The supplier shall be fully responsible for ensuring that all equipments forming part of the supply is entirely fit for the purpose and no part of this specification shall in any way remove or reduce his obligation in this respect. In addition, it is the supplier's responsibility to underwrite the complete air-conditioning system design and ensure that it is compatible with and will, in no way, compromise the design and performance of RMPU of his supply.

The supplier shall provide "In the field" service support during the guarantee period.

- 6.3 The supplier shall supply any purpose built or special tools or equipment that may be necessary for the correct operation, servicing, testing or installation of the air – conditioning equipment.

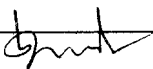
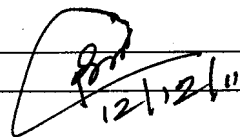
- 6.4 The supplier will provide assistance, both in terms of material and technical, in the development of the system as a whole to ensure that when this RMPU is installed as part of the integrated vehicle system, the performance of the system meets or exceeds the requirements specified.

- 6.5 If the RMPU fails to achieve these requirements, the RMPU shall be modified at the supplier's expense and within a time scale to be agreed with purchaser/consignee/RDSO.

7.0 TECHNICAL REQUIREMENTS

- 7.1 The air conditioning package unit shall be able to work satisfactorily on self-generating, end on generation & Head on generation (HOG) type AC coaches.

- a) Self-generating type coaches: Self-generating type coaches are provided with inverters to convert the output of $130 \pm 5\%$ V DC from the bogie mounted alternator to $415 \pm 5\%$ VAC, 3 phase, 50 Hz supply. The unit shall be suitable to work on PWM supply with the ripple content of $\pm 15\%$.
- b) EOG type coaches: Power is supplied through electric power cars at either end of the rake. Supply available is $415 \pm 5\%$ VAC, 3 Phase, 50 Hz.
- c) HOG type coaches: Power is supplied through bulk converter provided in locomotive or power car. Supply available is $415 \pm 5\%$ VAC, 3 phase, 50 Hz. But it is PWM with ripple contents of 15%.
- d) The microprocessor controller unit shall work on $110 \pm 30\%$ V DC/AC.
- e) The compatibility of the units with the above supplies shall be ensured by the manufacturer. Manufacturer shall study power supply characteristics before designing/selecting the sub-components of the system. Although, the sample

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wave form of the supply of AC coach is enclosed as annexure-D with microprocessor controller specification

- 7.2 The AC package unit shall have minimum 7.0 TR capacity to air condition the coach under the following conditions-

Summer condition	Dry bulb	Wet bulb	% R.H.
Outside (dry summer)	50°C	25°C	-
Outside (wet summer)	40°C	28°C	-
Inside (dry and wet)	20-25°C	-	60-40%
Winter conditions			
Outside	- 4°C		
Inside	17-21°C		

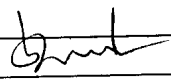
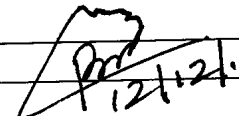
- The design of RMPU shall be such as to restrict relative humidity inside the air conditioning compartment under any circumstances to a maximum of 60%.
- The RMPU shall be able to work even with one condenser fan and cooling capacity so obtained shall not be less than 75% of rated capacity.
- The refrigeration system shall comprise two circuits i.e. two compressors, two condensers & two cooling coils, heaters etc.

- 7.3 Control and regulation function of the air conditioning system (two nos. RMPU) shall be performed by microprocessor controller unit with software installed in it, together with the Electrical components of the air conditioning system. All the information necessary for control and regulation, such as switching condition and temperatures etc. shall be processed and evaluated, taking into account the prevailing operating conditions and necessary safety precautions. The controller shall have fault diagnostic facility for continuous storage of various electrical faults in system, in a time sequence manner. It should be possible to down load the fault data from the controller to a PC/laptop for analysis purpose. The firm will supply the software for down loading and analysis of the failure data and performance parameters, to the purchaser and RDSO. The microprocessor controller shall be as per RDSO specification No. RDSO/PE/SPEC/AC/0139-2009-(Rev. 1).

- 7.4 In the normal operating mode (manual), the fresh air dampers of the unit shall be set to ensure envisaged fresh air volume of 26-m³/min.

8.0 GENERAL CONSTRUCTION OF AC PACKAGE UNIT

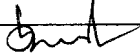
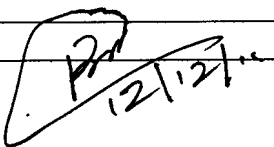
- 8.1 The AC package unit shall generally conform to RDSO Drawing No. RDSO/PE/SK/AC/0069 – 2004 (Rev.1). Manufacturer shall take prior approval of

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the structural drawing and the general layout of the components from RDSO. Bellows proposed to be used should also have approval of the RDSO. Bellows shall be waterproof and have fire retardant properties. It shall conform to RDSO specification No. RDSO/PE/SPEC/AC/0136 – 2009 - (REV. 0).

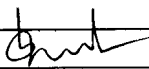
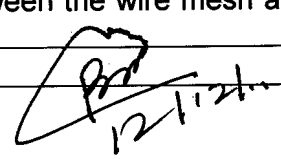
- 8.2 The Roof Mounted Package Unit shall be self-supporting and will not form part of the vehicle structure. For the module of unit, a separate structural frame shall be employed which will not rely on any of the installed components or equipment for rigidity or strength. All the parts that require periodic cleaning or maintenance shall be easily accessible when the unit is in installed condition. The parts that require periodical cleaning shall be easily removable with minimum tools and attended to for which facility shall be made available.
- 8.3 The unit shall be made of stainless steel SS 304 grade S2 to IS: 6911. Welded zones may be given necessary treatment after fabrication and shall not be painted. Thickness of the sheet shall be minimum 1.6 mm. Thickness of the sheet may be increased in some areas for adequate strengthening against vibration and shocks. The thickness of the channel/angle employed for structure shall not be less than 2.0 mm. Similarly, the thickness of the channel/angle provided for mounting motors, compressors & coils shall not be less than 2.5 mm.
- 8.4 Roof mounted AC package unit shall be capable of handling by overhead lifting gear without sustaining damage. The lifting points for this purpose shall be provided as given in RDSO drg. No RDSO/PE/SPEC/AC/0069 – 2004 (Rev.1). The supplier shall give the details of special handling requirement, if any.
- 8.5 The actual weight of the AC package unit after it weighment would be marked in the space as indicated in RDSO drawing no. RDSO/PE/SPEC/AC/0069 – 2004 (Rev.1). The actual weight of the AC Package unit shall not exceed 700 Kg.
- 8.6 The Roof mounted AC package unit will be so designed that it interfaces with the vehicle and does not allow rainwater, washing plant fluid and condensate to enter into the vehicle. The connection of the supply air opens to the main duct and the return air opening shall be through bellows with metallic frame at both the ends. The bellows shall be detachable from the unit as well as from the duct side. The connection of the duct/coach/and to the package unit would be through nuts and bolts. Bellows should be of superior quality of woven material as per RDSO specification No. RDSO/PE/SPEC/AC/0136-(Rev.0)-2009. It shall be of RDSO recommended make only. Bellows as well as their connections with the package unit should be water proof & fire retardant. The metallic frame shall have slide in arrangement, so that the bellow may be replaced without having to remove the unit from the coach.
- 8.7 The design and layout of RMPU shall be such as to prevent water traps even if the vehicle is stopped on the slope or cant. Proper water drainage arrangement shall also be provided. Each drip tray shall have drain holes/hole fitted with drainpipe to facilitate easy drainage of water without allowing out side air to be

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sucked inside the evaporator compartment. Drain pipe to drain out condensate water from drip trays, should be integral part of the drip tray and, if required will have suitable trap at free end, to prevent the condensate water being sucked in by blower and thrown in the supply air duct. Any change in the approved design/equipment requires prior approval of RDSO.

- 8.8 Drip trays, provided under cooling coils to collect condensate water should be of stainless steel SS 304 grade S2 to IS: 6911 and should have a depth not less than 60 mm. It's design should be such as to prevent spillage of water in evaporator compartment. The condensate water shall not be stored/collected in blower/runner area of evaporator compartment.
- 8.9 If required, both the refrigeration circuit of RMPU will have accumulator (optional) of adequate capacity to prevent liquid refrigerant from entering the compressors.
- 8.10 No external connections/fittings shall be provided by the purchaser while installing the RMPU. No material shall be used that will support infestation of any kind.
- 8.11 The RMPU shall be as light as possible without reducing reliability.
- No material shall be used in the construction of the unit that is liable to be adversely affected by the vibrations, damp, rotting or growth of modules. No timber shall be used. Use of asbestos is prohibited.
 - Fire protection: the design of all the parts and component of the unit shall meet the requirements of UIC 564-2 in the fire classification-1.
- 8.12 The evaporator compartment of the AC package unit shall be watertight and there should be no leakage of water into the evaporator compartment from outside as well as from bottom of the RMPU when tested for water tightness.
- Sealant over threads shall only be allowed. The sealant used shall have fire retardant properties.
- 8.13 The noise level generated by the running of the package unit in the installed condition shall be as low as possible, and not raise the resultant noise level inside the coach to more than 60 dB as per UIC 553, neither at standstill nor during operation. The condenser fans and the compressors shall have anti-vibration mounting to avoid structure borne noise transmission into the coach. The noise level shall be measured during commissioning of the unit.
- 8.14 A protective wire mesh guard/punched sheet metal guard shall be provided over the package unit covering the entire condenser portion. Protective guard shall be made from stainless steel wire of OD not less than 3 mm or punched steel sheet of thickness 2 mm. The guard shall be as shown in RDSO drawing no. RDSO/PE/SPEC/AC/0069 – 2004 (Rev.1). The gap between the wire mesh and

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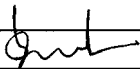

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the condenser fan blades shall not be less than 25 mm. Under any circumstances, the condensing coils cover should not touch with coils to protect it from damage during maintenance.

- 8.15 The compartment containing the cooling coils/heaters, blower fans shall be thermally insulated from all sides, top and bottom. The insulating material used shall be of fire retardant quality preferably resin bonded fiberglass or fire retardant polyethylene or combination of both or closed cell non-water absorbing fire retardant elastomeric melamine or any other suitable material. Manufacturer should obtain prior approval from RDSO for any other type of Insulating material proposed to be used. The technical details such as thermal conductivity, density, fire retardancy, water absorption and tensile strength etc of insulating material are to be furnished by the firm to RDSO. The thermal insulation shall be sandwiched and jacketed between two layers. The thermal insulation shall not be exposed outside from inside.
- 8.16 The evaporator blower shall be designed for air delivery at 20mm static head of water gauge.
- 8.17 The equipments/components in the evaporator compartment which require in service attention shall be easily accessible from top of the coach with the help of ladder under high-tension line. The top cover of the evaporator compartment shall be leak proof. A lever should be there to push open the top cover upward as shown in the RDSO Drg. No RDSO/PE/SPEC/AC/0069- 2004 (Rev.1). Necessary arrangement to hold the covers in open condition shall be provided during maintenance. The latches shall have sufficient strength and positive locking, so that the service cover does not open during service.
- 8.18 The package unit shall be installed above the false ceiling under the coach roof with condenser portion exposed.
- 8.19 Various equipments used shall have clear marking/rating plates.
- 8.20 RMPU should work on vapour compression refrigeration system with R-407C refrigerant.

In the system, the following shall be ensured:

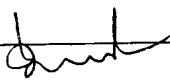

- i) Major equipments/components shall be replaceable on a unit exchange basis.
- ii) The design philosophy shall be of no leaks and a sealed system (with sealed scroll compressors).
- iii) The electrical and control connections shall be provided with locking arrangement and shall be easily accessible for maintenance.

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- 8.21 The electrical power & control connection to the motors, compressors and heaters etc shall be through four numbers heavy duty connectors (two on each side). The connectors shall be RDSO approved make as per annexure - I.
- 8.22 Two numbers of electrical junction boxes having aluminum die-cast face (front), on which the connector's base to be mounted, shall be provided on both sides. The design of aluminum die-cast face shall slightly be tapered towards bottom. It shall be ensured that under any circumstances the water should not enter into the electrical box. The rear portion of the box shall be stainless steel as per SS 304 grade S2 to IS: 6911. Din rail mounted terminal blocks shall be provided. The make of the terminal block shall be as per annexure - I. Power and control connection diagram of terminal blocks on aluminum plate with anodizing of black back ground or with silk screen printing in permanent nature shall be provided either from inside of the cover or on the top of cover of junction box. The diagram shall contain terminal number & wire number (ferrules) for easy identification for maintenance staff of Indian Railways.
- 8.23 The electrical junction box shall be fitted from inside of the opening provided for the same. It shall be ensured that there should be no water entrance from the opening made for the purpose.
- 8.24 The RMPU shall be marked with the following information in the front & back, as shown in the drawing:
1. Type/Make
 2. Serial Number
 3. Month and year of manufacture
 4. Weight
 5. Capacity in TR/Kcal/H (under specified condition)
 6. Power consumption (under specified condition)
 7. Refrigerant.....Quantity.....Kg.
- 8.25 Compressors, all motors, heaters and frame of the unit shall be provided with suitable flexible braided copper (tin coated) jumpers with crimped socket on either ends for double earthing. The earthing scheme of the unit shall generally be as per HFG drawing No. S65F-100.931-13A.Z4.
- 8.26 All the materials used in the unit shall be of fire retardant properties.
- 8.27 All the electrical equipments and wiring etc. on the RMPU shall meet the provisions of Indian electricity act and rules.
- 8.28 COMPRESSORS**
- 8.28.1 Only hermetically sealed scroll Compressors suitable for rolling stock application shall be used.

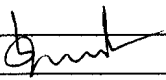
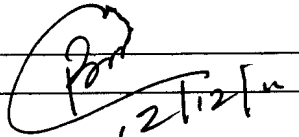
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- 8.28.2 The refrigerant compressors shall have minimum 3.5 TR capacity at 60°C condensing and 5°C evaporating temperature. The manufacturer shall furnish the design parameters of superheat and sub-cooling of refrigerant.
- 8.28.3 A clamp to hold the compressor from the top shall be provided. The top cover of condensing compartment shall not touch the compressor dome to avoid damage to compressor during service.
- 8.28.4 The rating of the AC package unit shall not be less than 7.0 TR at the conditions specified in the clause 7.2 of the dry summer conditions, keeping the maximum power consumption of the unit below 16.5 KVA.
- 8.28.5 The design having higher efficiency (TR/ KW) will be preferred.

8.29 HEAT EXCHANGERS

- 8.29.1 The heat exchangers (condensers) shall be air cooled and of adequate capacity to match the refrigeration system.
- 8.29.2 The evaporator unit shall comprise cooling and heating units with expansion valve.
- 8.29.3 The heat exchangers shall be made of copper tubes with aluminum fins.
- 8.29.4 To increase the operating life, the heat exchangers shall be pre-coated and shall pass 1000 Hours salt fog test as per ASTM B-117. In this regard, a test certificate from OEM/NABL accredited lab shall be furnished by the manufacturer.
- 8.29.5 The fins should be uniformly distributed throughout the entire length of the tubes. Spacers may be used to maintain uniform distance between the fins during manufacture before expansion of the tubes.
- 8.29.6 There should be adequate grip of the fins over the tubes and the fins should have flared collars so that during vibration, the fins do not come closer and collar of the fins does not go inside the holes of the adjacent fins thereby reducing the spacing. The coils shall be mechanically expanded.
- 8.29.7 The mounting details of the heat exchangers shall be furnished by the manufacturer at the time of prototype inspection.
- 8.29.8 Heating element shall cover entire supply air opening.
- 8.29.9 The condenser compartment should be suitably sealed to achieve the optimum condenser efficiency. The inlet air through condenser coil shall be ensured.

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8.29.10 Heat exchangers shall be provided with guard from top, bottom and sides to avoid damage during service.

8.29.11 Any new design of coil which gives better performance than existing type of coil can also be offered. Manufacturer shall submit complete details of such coil to RDSO before prototype test. RMPU with such design of coil shall be put on field trial before prototype clearance is granted.

8.30 FRESH AIR QUANTITY

8.30.1 The unit shall be able to supply fresh air at the rate of 0.35 m³/minute/person in all type of AC coaches.

8.30.2 Each air conditioning unit shall suck in outside ambient air from the lateral coach wall via the special grills provided in the coach.

8.30.3 Two adjustable air dampers (louvers) shall be installed in the unit. These louvers shall be adjusted manually and the design shall be made in such a way that they may be fixed at any position by means of locking arrangement and adjustment by lever as per the fresh air requirement. The louvers shall be adjusted at commissioning stage itself.


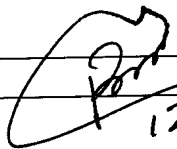
8.31 FILTERS

8.31.1 Each air conditioning unit shall have 2 fresh air and 2 return/mixed air filters. The fresh air filters shall be installed outside the air conditioning unit directly behind the fresh air intake grills in the upper part of the lateral wall of the coach. The mixed air filters shall have large intake area and shall be situated inside the unit. Mixed air filter shall cover entire face of the cooling (evaporator) coil to get the optimum utilization of their designed capacity. A separate housing to accommodate the mixed air filter shall be provided.

8.31.2 The fresh air filters and the mixed/return air filters shall be as per drawing No. RDSO/PE/SK/AC/0074-2004 (Rev.1) and RDSO/PE/SK/AC/0073-2004 (Rev.1) respectively. Only RDSO approved make filters shall be used.

8.31.3 The fresh air filters shall be serviced from the lateral side wall of the coach after opening the fresh air intake grille (cassette). The filter shall be easily pulled out from bellow/cassette. The cover of the cassette shall be designed in such a way that during service, it could not be unbolted/unscrewed/unlatched. The mixed air filters shall be serviced from the top after opening the two maintenance/service covers of the evaporator compartment. Access shall be possible by using a ladder without the necessity to climb on to the roof.

8.31.4 The proper procedure for cleaning of filters along with the cleaning agent, if required, shall be furnished from the OEM.

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8.31.5 The seat for return/mixed air filter will have necessary provision (pins) to accommodate and to match the filter having arrangement to avoid wrong fitment as per drawing no. RDSO/PE/SK/AC/0073 – 2004 (Rev.1).

8.31.6 A test certificate from OEM indicating serial number of filter, efficiency, dust holding capacity and initial/maximum pressure drop shall be furnished by RMPU manufacturer.

8.31.7 Arrangement should be available to lock the fresh and mixed/return air dampers at any position. Adjustment of dampers with locking arrangement should not get disturbed on its own during run.

8.32 HUMIDITY CONTROL

8.32.1 The humidity control or dehumidification process shall be started when required. The steps for this process shall be as per clause (B) of annexure – IV (enclosed with the specification)

8.33 SENSORS

8.33.1 The temperature at various locations shall be sensed by NTC sensors.

8.33.2 The following desired temperature settings shall be maintained inside the air-conditioned compartment by means of seven positions of the stepped rotary switch, provided on the switch panel:

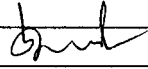
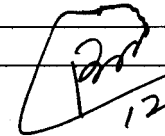
Position of the rotary switch	Temperature	
	Cooling	Heating
1.	20.0 deg. C	17.0 deg. C
2.	20.5 deg. C	17.5 deg. C
3.	21.2 deg. C	18.2 deg. C
4.	21.9 deg. C	18.9 deg. C
5.	22.6 deg. C	19.6 deg. C
6.	24.3 deg. C	20.3 deg. C
7.	25.0 deg. C	21.0 deg. C

8.34 REFRIGERATION PIPING

8.34.1 Refrigerant system shall comprise two circuits i.e. two hermetically sealed compressors, two condensers and two cooling coils and heaters.

8.34.2 The refrigerant pipe line shall be properly clamped and supported. Refrigerant pipelines/capillary tubes should not rub with each other.

8.34.3 Refrigerant copper piping shall be as short as possible. All joints shall be brazed/welded. The material of the copper piping shall conform to IS: 10773

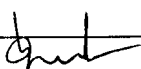
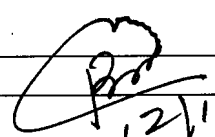
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(latest edition) meeting the dimensional requirements as per IS: 5493, subject to the minimum thickness of 1 mm. Inner grooved copper pipe shall only be used. Firm will submit a test certificate from any Govt. laboratory/Govt. recognized laboratory for confirmation of copper piping as per IS-10773 and dimensional requirement as per IS: 5493.

- 8.34.4 Each refrigeration system shall be separately protected by suitable safety devices, against over and under pressure. The control pressure switch shall have an automatic reset. If the control pressure switch operates the safety devices, this shall be recorded by the microprocessor controller unit and indicated. It shall be ensured that if the working pressure increases beyond 275 psig, the second condenser fan will be in working otherwise only one condenser fan will be in working condition.
- 8.34.5 Filter drier unit with sight glass shall be connected into the liquid refrigeration pipeline and shall be of RDSO approved make only as specified in annexure – I. The filter drier must be installed with flow in the direction of the arrow on the filter drier label.
- 8.34.6 The drier filter shall not be vacuumed or over pressurized before use.
- 8.34.7 Thermal/electronic expansion valve suitable for automobile application shall be used. The feeler/sensor of expansion valve shall be properly supported and clamped to avoid any damage due to vibration and rubbing. The feeler bulb of the expansion valve shall properly be thermally insulated, so that it can only sense the temperature of refrigerant coming out from the evaporator coil.
- 8.34.8 Expansion valves with external pressure equalization must be used. The equalizing line must be connected to the suction line immediately after the bulb.
- 8.34.9 The bulb shall not be located at the bottom of the suction line due to the possibility of oil lying in the bottom of the pipe causing false signals. The bulb should be mounted in the suction line just after evaporator coil and in a position corresponding to between 1 O'clock and 4 O'clock'. Similarly, equalizing line should be connected in the suction line immediately after the bulb.
- 8.34.10 The stainless steel liquid receiver of adequate capacity shall be provided in the liquid line.
- 8.34.11 The refrigerant circuit shall be provided with suitable pressure transducers as shown in drawing No. RDSP/PE/SK/AC/0071 – 2004 (Rev.1), so that the working pressure of refrigerants of different cooling circuits can be monitored by means of rotary switch, provided on switch panel.
- 8.34.12 Proper insulation shall be provided on suction line of refrigerant circuit.
- 8.34.13 Refrigerant circuit shall be protected against high and low pressure by providing HP/LP cutout switches. These switches shall be mounted directly on the

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refrigerant pipe line as shown in RDSO drawing No. RDSO/PE/SK/AC/0071 (Rev.1).

- 8.34.14 In case the HP/LP cut outs are mounted, where the rain water comes directly on it, a cover from the top shall be provided.

8.35 MOTORS

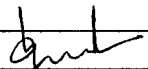
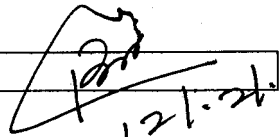
- 8.35.1 Motors provided in the package unit shall be continuously rated and shall conform to RDSO specification No. RDSO/PE/SPEC/AC/0089 – 2008 (Rev.0) with amendment No. 1 & 2 having IP-56 protection to IEC 60529. Insulation class of all the motors shall be 'H'. The motors shall only be of RDSO approved make.

The rating of the motor shall be as under:

Condenser fan motor	0.75 KW, 415V, 50 Hz., 1400 RPM (two nos.)
Blower motor	1.1 KW, 415V, 50 Hz., 1400 RPM (one no.)

- 8.35.2 Evaporator blower fan motors shall be capable of operating continuously under high ambient temperatures and under the effect of any radiant heat from the heater bank, which may be experienced during normal operation.
- 8.35.3 Grommets/gaskets/glands shall be provided at the cable entry holes.
- 8.35.4 The direction of the rotation of motors shall be arrow marked clearly on the cover over condensing area. Similarly, the rotation of blower motor shall be marked on the fan duct from outside. The marking shall be of permanent nature.
- 8.35.5 Manufacturer shall submit mounting details of condenser and blower motor alongwith the drawing of blower fan and condenser fan.
- 8.35.6 Fan impellers shall be directly coupled to their respective motors.
- 8.35.7 The condenser fans shall be made of Fire Retardant Plastic material blades with aluminum hub. The minimum required properties (mechanical, physical and thermal) for Fire retardant Plastic material used for condenser blade should be as following:

- Melting point(ASTM method D2177)- 218 deg.C
- Tensile stress (ASTM method D638)- 90 MPa
- Flexural stress (ASTM method D790)- 130 MPa
- Elongation @ Break (ASTM method D638)- 4 - 6%
- Impact strength (ASTM method D256A)- 6.0 Kg. cm./cm.
- Rockwell hardness (ASTM method D785)- 120 R. Scale
- Heat defelection temp. @ 18.5 Kg/cm² load- 180 deg.C (ASTM method D648)
- Flammability rating - V0 UL94
- Glass fibre/ash content - (ISO 345 1-1) 30 – 35%

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8.35.8 Air shall be drawn (not blown) over the cooling coil (i.e. suck through arrangement). Arrangement shall be made to prevent sucking of condensate water by evaporator blower motor.

8.35.9 The condenser fan blade and runner of the evaporator blower shall be dynamically balanced. Manufacturers will keep serial no., batch no., manufacturing date and balancing record and shall be produced before inspecting official, if demanded.

8.36 HEATER

8.36.1 The evaporator unit shall contain 6.0 kW heaters for heating of the coach during winter. These heaters shall be of highest reliability standard to obviate any fire hazard. Type/make of the heater shall be furnished by the firm.

8.36.2 The electrical heaters shall have following triple protection against their excessive temperature rise through protective devices:

- 1) Over heat protection
- 2) Intermediate protection and
- 3) Fusible link

Protection at S.No. 1 & 2 shall be actuated through microprocessor controller at 65 deg.C & 85 deg.C respectively, whereas the protection at S.No.3 is ultimate disconnection of power supply to heating elements at 130 deg.C. The logic is described at annexure-IV

8.37 CABLING/WIRING

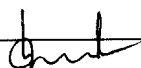
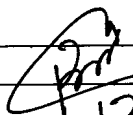
8.37.1 The cable sizes shall be as specified in RDSO drawing No. RDSO/PE/SK/AC/0072 –2004 (Rev.1)

8.37.2 Power and control cables shall run in separate pliable conduits of insulating material, in case the sheathed cable is not used.

8.37.3 The conduit shall be halogen free confirming to IEC 61386 – I or as per RDSO specification No. RDSO/PE/SPEC/AC/0138 (Rev.0)-2010. A certificate in support of conformity from OEM shall be produced by the firm. The connections of the accessories of the fittings with conduit shall have IP 67 protected, so that in any circumstance foreign material/water could not get entered into the conduit.

8.37.4 Cable should be so laid in RMPU that the removal of any defective cable is easily possible.

8.37.5 Earthing scheme shall generally be as per HFG drawing No. S65F-100.931-13A.Z4, enclosed with the specification.

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8.37.6 Cable shall be crimped at both ends with suitable copper lugs. Copper lugs having fire retardant shrinkable sleeve over it shall only be used.

8.37.7 Fire retardant computer generated cable markers shall be provided for identification of cables.

8.37.8 Compressors, all motors, heaters & AC package unit frame shall be provided with suitable flexible braided copper jumpers with crimped socket at either side of the jumpers for double earthing as indicated in HFG drawing No. S65F-100.931-13A.Z4.

8.36.9 Clearance and creepage distance shall be maintained as per IS:13947 (latest).

8.38 MICROPROCESSOR CONTROLLER UNIT

8.38.1 The microprocessor controller shall be of RDSO approved make as per RDSO specification No. RDSO/PE/SPEC/AC/0139-(Rev.0)-2009. The logic for control and regulation of the air-conditioning system is also enclosed with the specification of microprocessor controller.

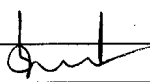
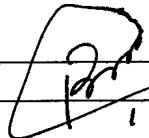
9.0 TESTS

9.1 Only after the drawings and the design have been approved and the clearance given to this effect, the manufacturer shall take up the manufacture of the prototype. It is to be clearly understood that any changes, required to be done in the prototype or any additional tests other than specified herein are required to be conducted on the prototype unit or its components, they shall be done expeditiously.

9.2 The type tests shall be carried out by RDSO representative on prototype unit either totally or in part under the following conditions without any additional cost:

- A manufacturer undertakes to manufacture for the first time as per this specification.
- An important change in design details of machine has been introduced.
- Specification is modified necessitating the re-designing of equipment.
- Unsatisfactory performance reported from user Railways.
- Resumption of production after an interruption of more than two years.

9.3 RDSO may conduct surprise checks on the manufacturing process and quality control along with any of the tests to ensure quality of product and its conformance to RDSO specification.

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9.4 Tests for AC Package Unit

The following tests shall be carried out at the works of manufacturer in presence of representative of Indian Railways on the prototype unit of the AC package unit as per the relevant governing specifications modified or amplified. The manufacturer shall have all possible necessary arrangements for testing of RMPU.

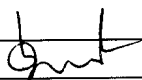

Testing/measuring instruments shall be calibrated from any Govt./Govt. recognized laboratory and should be available during type test.

S.No.	Test	Clause	Type	Routine	Acceptance
(i)	Dimensional and visual inspection	9.4.1	✓	✓	✓
(ii)	Test for water tightness	9.4.2	✓	✓	✓
(ii)	Electrical Test <ul style="list-style-type: none"> • Insulation resistance and high voltage test • Voltage change test • Frequency change test • High temp. start up test 	9.4.3	✓	✓	✓*
(iii)	Fresh air quantity test	9.4.4	✓	✓	✓*
(iv)	Conditioned air delivery test	9.4.5	✓	✓	✓*
(v)	a) Cooling capacity test	9.4.6 (a)	✓	✓	✓*
	b) Cooling capacity with one condenser fan	9.4.6 (b)	✓	✓	✓*
(vi)	Measuring of power	9.4.7	✓	✓	✓*
(vii)	Heating capacity test	9.4.8	✓	✓	--
(viii)	Shock and vibration test	9.4.9	✓	--	--
(ix)	Functional test of RMPU in conjunction with microprocessor controller including print out of recorded faults and event data.	9.4.10	✓	✓	✓*

* Tests to be done on 20% of the offered lot subject to minimum two number of RMPUs.

Commissioning tests:

The supplier shall associate during commissioning of their initial few RMPUs units.

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9.4.1 Dimensional and visual inspection

This includes checking the overall dimensions, correct electrical wiring, location of the lifting hooks, material of the filters, accessibility of the blower motor, filters and protective devices in the switch panel, quality of the welding and over all workmanship of RMPU.

9.4.2 Test for water tightness

The unit shall be tested by the manufacturer for the water tightness as per the test arrangement and test programme described below: -

9.4.2.1 Rain test:

The water tightness of the body and the electrical equipment boxes mounted outside the body shall be checked at all the openings, doors, covers, cover strips or crevices, which might allow penetration of the water or snow.

A distinction shall be made between the water tightness of the openings (Air inlet etc.), which depends primarily on the erection and condition of the joints.

i) A check on the water tightness of the openings shall form type test. It shall be carried out for a period of 30 minutes with all the fans running under the artificial rain of intensity not less than 60 mm per minute. The angle of the rain will be 45 degrees towards the evaporator compartment from the condenser side.

ii) A check on the water tightness of the covers shall be conducted. It shall be carried out by means of a jet of 6 to 10 mm internal diameter, at a distance of 2 meters and a pressure of 1 bar with all fans running and then a pressure of 3 bars with the fans stopped. The water shall be sprayed on each cover/side minimum for 15 minutes.

iii) In each case, the penetration of water shall not be of such nature as to have an adverse effect on cabling and electrical equipment or any other equipment necessary for maintaining the vehicle in proper working order.

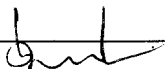
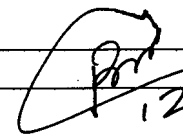
9.4.2.2 Test for condensate water:

This test will be conducted to see the efficacy of condensate water drain out system from the AC package unit. The firm will make a mock up incorporating the actual installation of AC package unit with blower motor in working condition.

9.4.3 Electrical tests

i) Insulation resistance

Insulation resistance of compressor & other motors shall not be less than 100 mega ohms with 1000V dc megger, in all weather conditions.

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ii) High Voltage Test

Work test certificate from original equipment manufacturer (OEM) certifying the equipment to withstand a voltage of 2000V AC for one minute shall be furnished.

iii) Voltage change test:

During the normal operation of the unit under cooling capacity test (clause 9.5.6) condition, the power source voltage will be changed from 375V AC to 460V AC.

The RMPU shall operate without any significant change of suction and discharge pressure.

iv) Frequency test:

During the normal operation of the unit under cooling capacity test (clause 9.5.6) condition, the power source frequency shall be changed to 47.5 to 52.5 Hz.

The RMPU shall operate without significant change of discharge and suction pressure.

High temperature start up test

The condenser room temperature shall be maintained at 57°C and the AC package unit shall be made to run for one hour.

The RMPU should work satisfactorily without tripping of any of the protective devices.

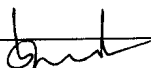
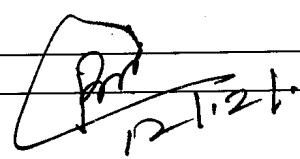
9.4.4 Fresh air quantity test

Measurement of fresh air quantity shall be made when the fresh air openings are in normal position and fresh air will be measured at 415 volts - 5% i.e. 394 volts. The fresh air quantity should not be less than 26 CMM.

9.4.5 Conditioned air delivery test:

This test shall be conducted by adjusting the static head of 20mm WG over the conditioned room air.

Air velocity measurements shall be recorded at both the return air openings. Both fresh air filters shall be closed & the conditioned air delivery should be within the value declared by the manufacturer in Annexure - II.

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9.4.6 a) **Cooling capacity test:**

This test shall be made in following conditions keeping the static head of supply air at 20 mm WG: -

Test condition	Condition created in hot chamber	Condition created in cold Chamber
Dry summer condition	50°C (DB) 25°C(WB)	25°C (DB) 16°C(WB)

1. a) **Cooling capacity from evaporator side shall be calculated as under:-**

$$C = \frac{60 \times Q \times (E1-E2)}{S}$$

Where C = Cooling capacity (K cal/h) evaporator side.
Q = Conditioned air quantity (m³/min) of evaporator blower fan.
E1 = Enthalpy of return air (K cal/kg)
E2 = Enthalpy of supply air (K. cal/kg)
S = Specific volume of return air (m³/kg.)

The capacity of the unit shall not be less than 7.0 TR under specified condition. The capacity of the individual refrigerant circuit shall not be less than 3.5 TR.

b) **Cooling capacity test with one condenser fan off:**

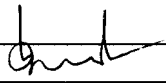
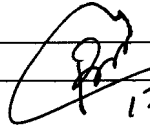
The cooling capacity with one condenser fan shall be carried out under the condition mentioned in clause No. 9.4.6.

2) **Cooling capacity from condenser side shall also be determined as under:-**

$$C_c = \frac{60 \times Q_c \times (E4-E3)}{S_c} - (E_t \times 0.86)$$

Where Cc = condenser side total cooling capacity (K cal/h)
Qc = Airflow rate over condenser per minute.
E3 = Enthalpy of air entering condenser (K cal/kg)
E4 = Enthalpy of air leaving condenser (K cal/ kg)
Sc = Specific volume of air flowing over the condenser (m³/kg)
Et = Total power input to module in watts in condenser.

The capacity from condenser side shall match the evaporator side capacity.

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Note: The temperature reading shall be taken when the steady state condition is achieved. However, the following variations in temperature measurement during capacity test under cooling as well as in heating mode shall be allowed:

Reading	Variation of arithmetical mean values from specified test conditions	Maximum variation of individual reading from rating conditions
Temperature of air Entering indoor side	$\pm 0.3^{\circ}\text{C}$ (DB) $\pm 0.2^{\circ}\text{C}$ (WB)	$\pm 1.0^{\circ}\text{C}$ (DB) $\pm 0.5^{\circ}\text{C}$ (WB)
Temperature of air Entering outdoor side	$\pm 0.3^{\circ}\text{C}$ (DB) $\pm 0.2^{\circ}\text{C}$ (WB)	$\pm 1.0^{\circ}\text{C}$ (DB) $\pm 0.5^{\circ}\text{C}$ (WB)

9.4.7 Measurement of power:

During the type test total power input to the complete RMPU as well as to each of the motors and compressors shall be recorded under the conditions specified in clause 9.4.6. The power consumed by the unit shall not be more than 16.5 KVA.

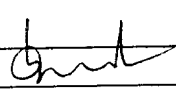

9.4.8 Heating capacity test:

The kW rating of heaters shall be measured which should not be less than 6.0 KW.

9.4.9 Shock and vibration test:

The RMPU is subjected to pass shock and vibration tests as per IEC from any NABL accredited/approved/recognized laboratory. The manufacturer shall submit complete detailed report to RDSO. The tests shall be conducted in the energized condition.

- 1) Shock and vibration tests shall be got carried out by the manufacturer as per IEC 61373 under the category 1 class A, location M as given in figure C1 to above mentioned IEC.
- 2) In case the facility for conducting shock and vibration test as per IEC-61373 is not available in India, than the vibration and shock test conducted as per IEC-77 (latest) may be accepted and it shall be done under the following condition:
 - a) The resonant frequency will be searched between 0-50 Hz at the critical locations of the unit. The vibration test shall be conducted in the energized condition for two hours each in all three directions i.e. lateral, Longitudinal and vertical direction, at critical frequencies. In

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case critical frequency is not observed, vibration test shall be conducted at 10 Hz.

- b) Shunting shocks test shall be conducted by giving 12 shocks of 3 g level each in the energized condition of unit in all the three direction.

(NOTE: Tests specified in clause 9.4.9 shall be carried out in energized condition)

9.4.10 Functional test of RMPU in conjunction with microprocessor controller including print out of recorded faults and event data

The following tests shall be carried out on RMPU in conjunction with microprocessor, as specified in RDSO specification No. RDSO/PE/SPEC/AC/0139 (Rev.1)-2009:

- 1) **Starting of compressors:** Both the compressors shall not be started at a time. First compressor of each unit should be started after 2 minutes from switching ON of AIR-CO switch. Second compressors of the units shall be started after a delay of 5 seconds from start of first compressors, if required.
- 2) **High Pressure switches:** The compressor should be switched OFF/tripped, if discharge pressure of compressor rises beyond limit of 430 psig. Once the compressor has been switched OFF, it shall not be started before 5 seconds even if it is required.

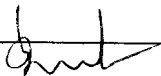
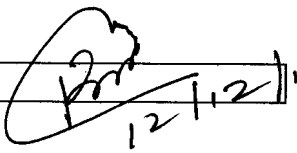
If the compressor tripped three times in one hour, the fault shall be stored/displayed by means of the glowing fault indication lamp provided on switch panel, in addition to LED indication.

In case both the compressors of any unit are switched OFF at a time, first compressor shall be started after 1 minute and other one after 5 seconds from start of the first compressor.

The provision shall be there to restart the unit in case both the compressors have been tripped three times in one hour.

- 3) **Low Pressure switches:** The compressor should be switched OFF/tripped, if suction pressure of compressor goes down beyond the limit of 30 psig. Once the compressor has been switched OFF, it shall not be started before 5 seconds even if it is required.

If the compressor tripped three times in one hour, the fault shall be stored/displayed by means of the glowing fault indication lamp provided on switch panel, in addition to LED indication.

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In case, both the compressors of any unit are switched OFF at a time, first compressor shall be started after 1 minute and the other one after 5 seconds from start of first compressor.

The provision shall be there to restart the unit in case both the compressors have been tripped three times in one hour.

- 4) **Control Pressure switch:** Control pressure switches are provided in each circuit to monitor the discharge pressure of compressor. If the discharge pressure is below 275 psig, only one condenser fan will be in working. If the discharge pressure rises above 275 psig, the second condenser fan shall be started (both condenser fans will run).
- 5) **Thermal over load protection:** Thermal over load protection devices are embedded in the winding of each motor, which allows to disconnect motor supply through contactor, if the winding temperature of the motor rises above 130°C and shall be automatically re-started when the temperature of the winding comes down. The message shall be displayed by means of LED indication on controller unit.

If it happens three times in one hour, the fault shall be indicated by means of fault indication lamp provided on switch panel in addition to LED indication on controller unit.

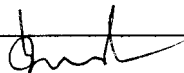
(NOTE: The fault indication light provided on switch panel should be reset by turning AIR-CO switch off. The OFF time of motors under this condition shall also be recorded/stored in memory of the controller.)

- 6) **Over heat protection (OHP) for heater:** During heating mode in winter, the overheat protection switch shall take care for the excessive heating of supply air. If the supply air temperature reaches beyond the set value i.e. 65°C due to any reason, the OHP will react immediately to disconnect the power supply to the heater through controller and will block the heater working further. The blinking message shall be displayed for the same on display unit. The heating facility shall be available only by re-switch ON of AIR-CO switch. This event shall be recorded/stored in controller memory with the time and at which temperature it has acted.


For any reason, if OHP not acted at 65°C and the temperature rises up to 85°C, the respective contactor of the heater shall be open through microprocessor controller.

- 7) **Fusible link (ESTI):** In case OHP fails to perform to disconnect the power supply at 65°C supply air temperature, a Fusible link (ESTI) having setting to operate at 130°C shall be operated by way of bursting the bulb to disconnect the power supply permanently.

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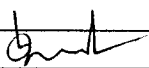
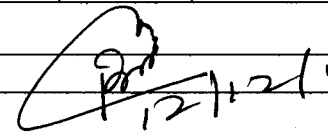
8) **Shut down of RMPU keeping in view the safety aspect:** The Unit shall automatically be shut down through the microprocessor controller in the following conditions:

- a) If supply air temperature goes below 5°C
- b) If supply air temperature goes above 85°C

9) There shall be a provision of Rotary switch on the switch panel to switch over the unit in manual mode. In manual mode, heater shall be isolated from power supply. The system shall accept an input for the manual mode. if the system is put in manual mode, the same will be recorded as a FAULT in system memory.

10) **Data down loading:** After creating the fault artificially, the stored data shall be down loaded and a computer print shall be taken out. Format for the downloading event recording (in every 5 minutes) and failure data shall be as under:

Coach No.	PP/NPP side (PP = unit no. 1 and NPP side= unit is)	Data type (Logged/Fault)	Date & Time	Set temp.	Return air temp	
					Unit 1 (RT 1.1)	Unit 2 (RT 1.2)
1	2	3	4	5	6	7
Humidity					Supply air-temp	
Unit 1		Unit 2			Unit 1 (ST 1.1)	Unit 2 (ST 1.2)
HU 1		HU 2				
8		9			10	
LP status Unit 1		LP status Unit 2		HP status Unit 1		
LP 1.1	LP 1.2	LP 2.1	LP 2.2	HP 1.1		HP 1.2
Ok/Not Ok	Ok/Not Ok	Ok/Not Ok	Ok/Not Ok	Ok/Not Ok		Ok/Not Ok
11	12	13	14	15		16
HP status Unit 2		OHP status		Blower motor contactor status		
HP 2.1	HP 2.2	OHP 1	OHP 2	BLR 1.1	BLR 2.1	BLR 1.2* BLR 2.2*
Ok/Not Ok	Ok/Not Ok	Ok/Not Ok	Ok/Not Ok	Ok/Not Ok	Ok/Not Ok	Ok/Not Ok
17	18	19	20	21	22	23 24
Condenser motor contactor Unit 1 status		Condenser motor contactor Unit 2 status		Compressor contactor unit 1 status		
CD 1.1	CD 1.2	CD 2.1		CD 2.2	CP 1.1	CP 1.2
Ok/Not Ok	Ok/Not Ok	Ok/Not Ok		Ok/Not Ok	Ok/Not Ok	Ok/Not Ok
25	26	27		28	29	30
Compressor contactor unit 2 status				Heater contactor unit 1 status		Heater contactor unit 2 status
CP 2.1		CP 2.2		HTR 1		HTR 2
Ok/Not Ok		Ok/Not Ok		Ok/Not Ok		Ok/Not Ok
31		32		33		34
400 V status	Condenser motor TOP Unit 1 status			Condenser motor TOP Unit 2 status		
Ok/Not Ok	CDT 1.1		CDT 1.2	CDT 2.1		CDT 2.2
	Ok/Not Ok		Ok/Not Ok	Ok/Not Ok		Ok/Not Ok
35	36		37	38		39
Blower motor TOP Unit 1 status			Blower motor TOP Unit 2 status			Ambient temp. status
BLRT 1			BLRT 2			Unit 1 (AT) Unit 2 (AT)

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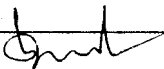
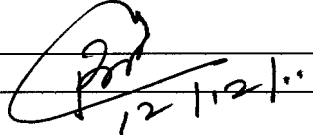
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Ok/Not Ok		Ok/Not Ok		1.1)	1.2)
40		41		42	43
Compressor duty cycle Unit 1 status			Compressor duty cycle Unit 2 status		
CP 1.1		CP 1.2	CP 2.1		CP 2.2
44		45	46		47
Failure of temperature sensors					
Return air temp. unit 1 status	Return air temp. unit 2 status	Supply air temp. Unit 1 status	Supply air temp. Unit 2 status	Ambient temp. unit 1 status	Ambient temp. unit 2 status
RT 1	RT 2	ST 1	ST 2	AT 1	AT 2
48	49	50	51	55	53
Status of All temp sensors in unit 1	Status of All temp sensors in unit 2				
ALLT 1 ok	ALLT 2 ok				
54	55				

* Provision shall be made in the controller in case two blower motors are used.

10.0 TECHNICAL DATA

- 10.1 The technical information as per Annexure II "Questionnaire on offer of Roof Mounted A/C Package Unit" complete in all respect should be furnished at the time of prototype testing.
- 10.2 The manufacturer shall indicate their compliance or other wise against each clause and sub-clause of the technical specification. The manufacturer shall enclose a separate statement for this purpose, if necessary, indicating the Annexure and clause reference and compliance or otherwise.
- 10.3 The manufacturer shall submit complete design details of condenser coil and evaporator coil along with basis of capacity selection the before prototype RMPU is offered. Necessary calculation shall also be submitted.
- 10.4 The manufacturer shall also supply following drawings in CD:
1. Layout drawing showing the important dimensions of RMPU showing locations of various equipments, refrigerant piping alongwith its holdings.
 2. Structural frame drawing showing size of various sections used & gauge of stainless steel sheet provided.
 3. Dimensional drawings of fresh and air return filters.
 4. Drawings of condenser and evaporator coil with mounting details.
 5. Drawings for mounting arrangement for evaporator and condenser motor.
 6. Operating Instructions
 7. One set of the following documents will be supplied with every 20 RMPUs.
 - a) Operating and trouble shooting manual.
 - b) Parts illustrated catalogue indicating sources.

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11.0 MAINTENANCE MANNUAL

- 11.1 The general maintenance requirement for the unit should be of cleaning of filters and blowing of dust etc. from the unit. The requirement for greasing should not be earlier than 18 months. However, the firm will submit the recommendations on maintenance requirement of RMPU, which should contain periodicity, work content and justification for each maintenance requirement.

12.0 GUARANTEE/ WARRANTY

- 12.1 Guarantee/warranty obligation of the equipments shall be as per IRS condition of contract.

13.0 INFRINGEMENT OF PATENT RIGHT

- 13.1 Indian Railways shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of similar components in the design & development of this item and any other factor not mentioned herein which may cause such a dispute. The entire responsibility to settle any such disputes/matters lies with the manufacturer/ supplier.

Details / design/documents given by them are not infringing any IPR and they are responsible in absolute and full measure instead of railways for any such violations. Data, specifications and other IP as generated out of interaction with railways shall not be unilaterally used without the consent of RDSO and right of Railways / RDSO on such IP is acceptable to them.

14.0 TRAINING

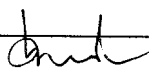
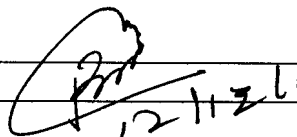
- 14.1 The contractor shall undertake to train, free of cost, the supervisors & staff of the Indian Railways for operation, maintenance, fault finding, trouble shooting, repair of the offered RMPUs under the guidance of the skilled engineers as and when asked for by Railways.

15.0 SCHEDULE OF TECHNICAL REQUIREMENT

- 15.1 STR of this item shall be RDSO/PE/STR/AC/0008– 2003 - (REV. 1)

16.0 SERVICE ENGINEERS

- 16.1 The manufacturer shall be required to make available the services of his engineers free of cost to monitor performance of the equipment in service periodically and also carry necessary repairs or replacement under warranty obligations. The necessary spares needed for replacement during service should be available with the service engineers at all the possible places where these coaches are maintained.

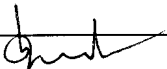

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17.0 CARTEL FORMATION

- 17.1 The firms will not engage in cartel formation with other firms and will also submit a declaration in this regard as per annexure III attached.

18.0 ENCLOSURES

- | | | |
|------|---|--------------|
| 18.1 | Accepted make of equipments. | Annexure I |
| 18.2 | Questionnaire on offer for Roof Mounted AC Package. | Annexure II |
| 18.3 | Proforma against cartel formation to be furnished by the manufacturer | Annexure III |
| 18.4 | Logic and control to be performed by the controller | Annexure IV |
| 18.5 | List of faults | Annexure V |
- 18.5 Latest version of the drawings mentioned below shall be followed:
- 1) RDSO drawing No. RDSO/PE/SK/AC/0069 – 2004 (Rev 1) - Roof Mounted AC Package Unit for LHB variant AC coaches (General arrangement & dimensional requirements)
 - 2) RDSO drawing No. RDSO/PE/SK/AC/0125–2009 (Rev 1) - Switch panel for RMPU (LHB & double decker AC coaches)
 - 3) RDSO drawing No. RDSO/PE/SK/AC/0071–2004 (Rev 1) - Air conditioning system for RMPU (LHB variant AC coaches)
 - 4) RDSO drawing No. RDSO/PE/SK/AC/0072–2004 (Rev 1) - Wiring diagram of RMPU (LHB variant AC coaches)
 - 5) RCF drawing No. SKED-625 – Modified wiring diagram for Roof Mounted AC Package Unit
 - 6) HFG drawing No. S65F-100.900-00A.S4 (in seven sheets) for wiring on electrical box (-X1, -X2, -X3 & -X4)-For relevant reference of wires and connectors as per requirement of the specification.
 - 7) HFG drawing No. (3)11.0788-101-61 (in seven sheets) for relevant references of control wiring.
 - 7) HFG drawing no. S65F-100.931-13A.Z4 for earthing scheme.

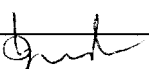
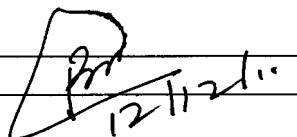
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ANNEXURE-I

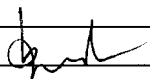
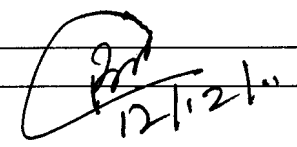
Specification No.RDSO/PE/SPEC/AC/0061- 2005 (Rev-1)

ACCEPTABLE MAKES OF EQUIPMENT

S. No	Description	Quantity	MAKE
1	Compressors (Scroll type)	2 Nos.	Emerson climate Model No. ZR 61 KCE TFD 522
2	U loop copper connectors at suction & discharge of compressors (2 for each compressor)	4 Nos.	Firm's own make
3	Condenser fan motor, as per RDSO specification No. RDSO/PE/SPEC/ AC/0089 (Rev.0) with amendment No.1 or latest	2 Nos	As per RDSO approved sources.
4	Condenser fan (FRP blade) having Physical, mechanical & Chemical properties as given in RDSO specification.)	2 Nos	Multiwing/Everfine/Hascon or any other make with prior approval of RDSO.
5	Cooling coil	2 Nos	Firm's own make or RDSO approved make
6	Blower fan motor with double extended shaft, as per RDSO specification No. RDSO/PE/SPEC/AC/0089 (Rev.0) with amendment No.1 or latest	2 Nos	As per RDSO approved sources.
7	Filter cum drier	2 Nos.	Danfoss/Alco/Spolon or any other make with prior approval of RDSO.
8	Blower fan	2 Nos	----
9	Thermostatic expansion valve (One in each refrigeration circuit.)	2 Nos	Danfoss/Alco/Sporlon or any other make with prior approval of RDSO.
10	Three phase stainless steel heater element	1 set	----
11	High pressure cut out/Switch direct mounting type (cartridge pressure control)	2 Nos	Danfoss/ Alco or any other make with prior approval of RDSO.
12	Low pressure cut out/Switch direct mounting type	2 Nos	Danfoss/ Alco or any other make with prior approval of RDSO.
13	Overheat Protector Protection switch (Setting 65 Deg.C Max.)	1 No.	Alert or any other make with prior approval of RDSO
	Fusible link (Setting 130 Deg.C Max.)	1 No.	ESTI MAKE, ESTI-SCHALTE EDA 25 or any other make with prior approval of RDSO

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14	Stainless steel drip tray for evaporator coils	2 Nos	----
15	Compressor anti- vibration mounting required	As required	-----
16	Condenser motor anti-vibration mounting	As required	-----
17	Anti-vibration mounting pads for overall package Unit	4 Nos.	Resistoflex (CFX 70E) or any other RDSO approved make.
18	Copper piping (As per IS:10773 with dimensional requirement as per IS: 5493, Material Code C-12200 when tested as per ASTM B-68/75/743)	As required	-----
19	Water proof bellows made of fire retardant material with metallic frame at both ends (As per RDSO spec. RDSO/PE/SPEC/AC/0136 (Rev.0)-2009	5 Nos	Navair/Delkon or any other make recommended by RDSO.
20	Cable for power (e-beam) RDSO specification No. RDSO/SPEC/ELC/0019 (Rev.0)-2002 or latest	As required	As per RDSO approved sources
21	Cable for control PTFE as per JSS 50134	As required	-----
22	Fresh & Return filters	2 Nos each	As per RDSO approved sources
23	Non-metallic conduit	As required	Polyamide Halogen free as per IEC 61386 - I
24	Structure & sheet material	As required	SS 304 grade S2 as per IS:6911
25	Refrigerant sight glass	2 Nos.	Danfoss/Alco or any other make with prior approval of RDSO.
26	NTC temperature	2 Nos.	With prior approval of RDSO.
27	Connectors for power & control (Cage clamp type)	4 Nos.	HARTING make Han E type connector with silver plated crimped terminals i)24 pins Harting part No. 09300240301 (base with two lever), 09330242602 (Male insert), 09330242702 (Female insert), 09300240510 (Hood) with suitable pin as per cable size. ii)16 pins Harting part No. 09300160301 (base with two lever), 09330162602 (Male insert), 09330162702 (Female insert), 09300160510 (Hood) with suitable pin as per cable size. OR

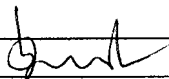
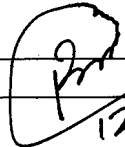
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			Equivalent Hypertac make with silver plated crimped terminals or any other make with prior approval of RDSO
28	Insulating material	As required	-
29	Dehydrator cum filter for liquid line	2 Nos.	Danfoss/Alco
30	Pressure transmitter/sensor/transducer	04	Alco/WIKA Eco R-1/Danfoss/Baumer/ Thermokon
31	Indicating instruments	-	SIFAM or any other make with prior approval of RDSO.
32	Indicator lamps	-	GROUP SCHIENDER/Siemens
33	Cable marker (Computer generated)	-	Tyco/Phoenix contact/Panduit
34	Crimping sockets/lugs	-	As per ICF/RCF approved sources
35	Heat Shrinkable sleeve	-	Tyco/Phoenix contact/Panduit
36	Rotary Switch	-	KAYCEE/GE/Salzer
37.	Terminal blocks	As required	Wago/Phoenix contact

Note :

- 1) Heat shrinkable sleeves, terminal blocks and cable marker shall have fire retardant properties grade V0 as per UL94.
- 2) Any other make and model of equipment/component can only be considered with prior approval of RDSO.

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Annexure II

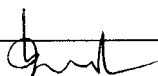
To RDSO specification No. RDSO/PE/SPEC/AC/0061- 2004(Rev-1)

QUESTIONNAIRE ON OFFER FOR ROOF MOUNTED A/C PACKAGE UNIT FOR LHB TYPE AC COACHES

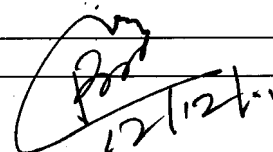
(The firm should fill each and every column)

S. No.	DESCRIPTION	MAKE PROVIDED
A).	A/C PACKAGE UNIT	
i).	A/C Package unit model/type	
ii).	Name of the Manufacturer	
iii).	Cooling capacity of the unit offered at 5 deg. C evaporating temperature and 60 deg. C at condensing temperature.	
iv).	Over all dimensions a) Length along the coach b) Width across the coach c) Height	
v).	Weight of package unit	
vi).	Name of the Refrigerant used Sub cooling Super heating	
vii).	Conditioned air out put at 20 mm WG static head	
viii).	Fresh air quantity at 375 V ac, 50 Hz.	
ix).	Total power input for the unit Under specified condition at a).Cooling b).Heating	
x).	Starting duty a).Starting current with duration	
xi).	Rated voltage, frequency and phase of power supply input	
xii).	Full load current at a).Rated voltage b).Minimum voltage	
B).	COMPRESSOR UNIT	
	Compressor	
i).	Manufacturer's name	
ii).	Type and Model No.	
iii).	Refrigeration capacity at 5 deg. C suction and 60 deg.C condensing temperature	
iv).	Name of refrigerant	
v).	Power required to drive compressor at specified Conditions at (iii) above	
vi).	Power required under specified conditions in	

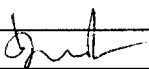
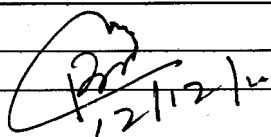
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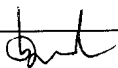
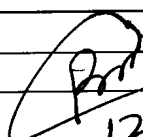
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	KW per ton of refrigeration at (iii) above	
vii)	Rated speed	
viii)	Type of bearings	
ix)	Drawing/sketch No.	
	Pressure cut outs (LP, HP and pressure control) Make Type Range Differential setting available Contract available	
x)	Drawing/Sketch No. (Firm's sketch shall be enclosed)	
xi)	Total weight of Compressor unit	
xii)	Overall dimensions of Compressor unit (Firm's sketch shall be enclosed)	
xiii)	Details of spares	
xiv)	Normal working voltage	
xv)	Rated speed Rated current a) At rated voltage b) At minimum voltage	
xvi)	Frequency	
xvii)	Phase	
xviii)	Type cooling	
xix)	Class of insulation	
xx)	Type of enclosure	
xxi)	Efficiency at full load	
xxii)	Peak current with duration at starting	
xxiii)	Direction of rotation	
xxiv)	Starting torque/full load torque developed	
xxv)	Details of anti vibration mountings provided Make/Type Material	
C).	REFRIGERANT CONDENSER UNIT	
i)	Manufacture's name	
ii)	Type and model No.	
iii)	Heat rejection capacity Kcal/hr.) at condensing Temperature 60 deg. C	
iv)	Cooling air temperature a) Inlet b) Out let	
v)	Total nos. of tubes	
vi)	Total nos. of tubes per row	
vii)	Nos of rows	

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viii)	Material and diameter of tubes	
ix)	Material and size of bends	
x)	No. Of fins per 25 mm	
xi)	Gap between fins	
xii)	Material and gauge of fins	
xiii)	Type of fins	
xiv)	Total cooling surface area of fins and tubes together	
xv)	Nos. & Details of a) Inlet pipe size b) Outlet pipe size	
xvi)	Corrosion treatment	
xvii)	Method of cleaning	
xviii)	Overall dimensions	
xix)	Face area in sq. mm	
xx)	Drawing/sketch including mounting details	
xxi)	Weight of condenser unit	
D)	CONDENSER FAN	
i)	Manufacturer's name	
ii)	Type of mountings	
iii)	Nos. of fans	
iv)	Air displacement	
v)	Nos. and material of blades	
vi)	Type of bearing	
vii)	Face velocity of air blown Over the condenser	
viii)	Material and nos. of fan blades	
ix)	Drawing/sketch no. indicating it's mounting details (To be submitted by the firm)	
x)	Weight of the fan	
xi)	Is fan blade's properties meets the requirements, specified in RDSO spec.	
E)	CONDENSER FAN MOTORS	
i)	Manufacturer's name	
ii)	Type, model and make	
iii)	Nominal voltage	
iv)	Rated speed	
v)	Continuous rating (HP/KW)	
vi)	Rated current a) At rated voltage b) At minimum voltage	
vii)	Frequency	
viii)	Phase	
ix)	Type of cooling	
x)	Type of insulation	
xi)	Type of enclosures	

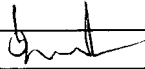
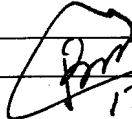
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xii)	Efficiency at full load	
xiii)	Peak current with duration at starting	
xiv)	Ambient temperature	
xv)	Weight	
xvi)	Direction of rotation	
xvii)	Starting torque/full load torque	
xviii)	Coupling arrangement of fan and motor	
xix)	Degree of protection provided for enclosures	
xx)	Details of anti-vibration mounting provided a) Make/Type b) Material	
xxi)	Frame size	
xxii)	Shaft details	
xxiii)	Is motors are as per RDSO specification No. RDSO/PE/SPEC/AC/0089-(Rev.0)-2008	
F)	DEHYDRATOR – CUM – FILTER AND LIQUID RECIEVER	
i)	Manufacturer's name	
ii)	Type and model no.	
iii)	Frequency of replacement	
iv)	Sight Glass in liquid line Make & Type	
v)	Make, model and type of liquid receiver	
G)	EVAPORATOR UNIT, BLOWER FAN & EXPANSION VALVE	
	Evaporator	
i)	Maker's Name	
ii)	Type and model no.	
iii)	Capacity (cal/hr) at Evaporation temperature of 5 deg. C	
iv)	Rated heater capacity	
v)	Total numbers of tubes	
vi)	Number of rows	
vii)	Number of tubes per row	
viii)	Material and size of tubes	
ix)	Number and size of bends	
x)	Number of fins per 25 mm	
xi)	Gap between tubes	
xii)	Material and gauge of fins	
xiii)	Type of fins	
xiv)	Total cooling surface area of tubes and fins together	
xv)	Face area	
xvi)	Detail of condensate water drip tray	
xvii)	Corrosion treatment	

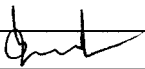
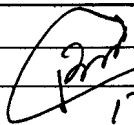
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xviii)	Overall dimensions of drip tray	
xix)	Drawing/sketch No. including mounting details (To be submitted by the firm)	
xx)	Weight	
xxi)	Detail of heater a) Rating b) Type	
xxii)	Detail of distributor type, Nos and size	
xxiii)	Expansion valve a) Make, model and type b) Pressure drop c) ID and OD d) Details of external/internal; equalizer	
H)	BLOWER	
i)	Manufacturer's name	
ii)	Type and model no.	
iii)	Number of fans	
iv)	Displacement of fans (m-cub/hr.) at 20 mm WG static head.	
v)	Number and material of impeller	
vi)	Type of bearing	
vii)	Face velocity of air blown over the Cooling coil	
viii)	Static head (WG)	
ix)	Pressure drop across the coil (WG)	
x)	Runner	
xi)	Weight	
xii)	Drawing/Sketch	
I)	BLOWER FAN MOTOR	
i)	Manufacturer's name	
ii)	Type, model and make	
iii)	Nominal voltage	
iv)	Rated speed	
v)	Continuous rating (HP/KW)	
vi)	Rated current a) At rated current b) At minimum voltage	
vii)	Frequency	
viii)	Phase	
ix)	Type of cooling	
x)	Class of insulation	
xi)	Type of enclosure	
xii)	Efficiency at full load	
xiii)	Peak current with duration of starting	
xiv)	Ambient temperature	


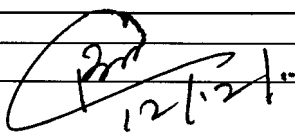
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xv)	Weight	
xvi)	Drawing of winding with complete details	
xvii)	Direction of rotation	
xviii)	Starting torque/full load torque	
xix)	Degree of protection provided	
xx)	Detail of anti-vibration mounting provided	
xxi)	Frame size	
xxii)	Shaft details	
xxiii)	Is motors are as per RDSO specification No. RDSO/PE/SPEC/AC/0089-(Rev.0)-2008.?	
J)	CONTROL	
i)	Make & model of microprocessor controller	
ii)	Location & No. of temperature sensors and its: <ul style="list-style-type: none"> i) Make ii) Voltage iii) Tolerances iv) Voltage v) Switching point vi) Reswitching vii) Temperature sensor 	
iii)	Temperature setting for cooling and heating	
iv)	Differential in deg. C for cut-in & cut-out of Thermostat	
v)	Detail of HP cutout/switch <ul style="list-style-type: none"> Make/Type Setting Range 	
vi)	Detail of LP cutout/switch <ul style="list-style-type: none"> a) Make/Type b) Setting c) Range 	
vii)	HP setting for cutout	
viii)	LP setting for cutout	
ix)	Details of over heat protector	
x)	Details of fusible link <ul style="list-style-type: none"> a) Type/make b) Switching point c) Nos. provided 	
xi)	Microprocessor controller <ul style="list-style-type: none"> a) Make/type b) Size c) Nos. of analogue input d) Nos. of digital input e) Nos. of analogue output 	

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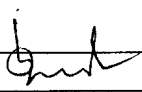
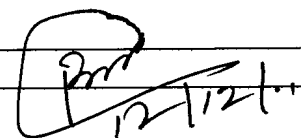
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	f) Nos. of digital outpt g) CAN-interface available or not h) Power consumption i) Rated voltage j) Governing specification	
K)	FILTERS	
i)	Make and Type of filter (Dry/wet)	
ii)	Overall dimensions a) Fresh air filter b) Return/mixed air filter	
iii)	Filtration efficiency	
iv)	Resistance drop across filter a) Fresh air filter b) Return/mixed air filter	
v)	Method and frequency of clearing	
L)	MOUNTING AND OTHER DETAILS	
i)	Mounting details of the package unit Offered design and structural frame Details	
ii)	Protection required on the coach roof For safety of Roof Mounted AC Package Unit against rain, water filling of coaches and damage from the traveling public/staff	
iii)	Drainage arrangement for the condensate water	
iv)	Details and dimensions for access doors from top and locking arrangement for attention to : • Fresh air filter • Return air filter • Thermostats • Pressure Cut outs • Blower fan motor etc.	
v)	Lifting arrangement for mounting and dismantling the unit from the coach (separate write up to be submitted by the firm)	
M)	DETAILS OF MATERIAL SPECIFICATION, DIA AND THE THICKNESS OF THE REFRIGERANT PIPE	
i)	Sheet material, thickness, grade and governing IS	
ii)	Channel material, thickness, grade and governing IS	
iii)	Liquid line	
vi)	Discharge line	
v)	Suction line	
vi)	Bends	

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v)	Details of WAGO connectors a) Type b) Part no. for power c) Part no. for control	
vi)	Details of PG glands a) Name b) Type c) Size etc.	
vii)	Details of terminal blocks a) Type/Make b) Part no. for power c) Part no. for control	
N)	<p>Details of Connectors & Accessories (Part No. and rating etc.)</p> <p>Connectors (M/F) 24Pins Harting part No.</p> <p>i) Base with two lever ii) Male insert iii) Female insert iv) Hood v) Pin & size.</p> <p>16 pins Harting part No.</p> <p>vi) Base with two lever vii) Male insert viii) Female insert ix) Hood x) Pin & size for: a) Compressor b) Blower motor c) Condenser motor</p> <p>Total number of connector used i) 24 Pins ii) 16 Pins</p>	
	Protection Hose	
	Connecting fittings	
	Elbow screw & joints etc.	

- Note :**
1. Write NA, if not applicable
 2. Each column is required to be filled.
 3. The firm should produce the documentary evidence in support of details furnished.

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ANNEXURE III to
RDSO Specification No. RDSO/PE/SPEC/AC/0061- 2004(Rev-1)

UNDERTAKING AGAINST CARTEL FORMATION

We, hereby, give an undertaking that as a Registered Vendor for manufacture and supply of, will not be a part of a cartel with other vendors and will be quoting competitive rates in the tenders invited by the Indian Railways/PUs.

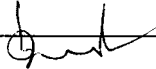

We are aware of the fact that the Registering Authority i.e. RDSO may de-list the name of our firm from the Master List of Approved Vendors if complaint is received about such cartel formation from any of the Railways/Production Units.

Seal and signature
(Authorised signatory of the firm)

Date:

Place:

Seal:

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ANNEXURE- IV

THE LOGIC AND CONTROL TO BE PERFORMED BY MICROPROCESSOR CONTROLLER PROVIDED IN LHB VARIANT AC COACHES

The controller shall perform the following functions concerning control and regulation of air-conditioning system to maintain the desired comfort condition inside the coach:

1. The controller will activate immediately after getting 110±30% V AC/DC supply.
2. The controller shall perform self diagnostic checks such as Watch dog & Real time clock, Memory OK & RAM OK. If they are OK, it shall be indicated by glowing LED for Controller OK. An additional LED shall also be provided on controller for controller not OK.
3. The controller shall also monitor the power supply voltage and give indication by LED for 400 V OK. If it is not OK and the same shall be stored in controller faults memory.

(Note : The activity from 1 to 3 shall be completed within 90 seconds maximum)

4. If controller is OK, the controller shall monitor the outside ambient, return air temperature & Relative humidity at supply air and perform the following as per the requirement:
 - a) Normal cooling & heating
 - b) Dehumidification mode
 - c) Emergency Operation
 - d) Safety devices operation under various operation of mode, such as HP/LP/control pressure switch, TOP, OHP.
 - e) Manual operation

- 4.1 After appearing 400 V OK signal on controller unit, the controller shall be ready to perform the control, regulation & smooth operation of RMPU.

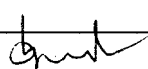
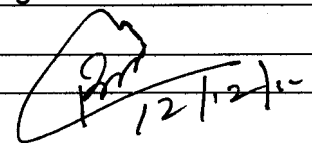
A. NORMAL COOLING AND HEATING

A.1 Normal cooling

- A1.2 In normal cooling, the controller shall perform control & regulation of the air-conditioning system (RMPU).

- A1.3 The various setting for cooling & heating are as under:

Position of set temperature selection	Cooling set point	Heating set point
1.	20.0 deg. C	17.0 deg. C
2.	20.5 deg. C	17.5 deg. C

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3.	21.2 deg. C	18.2 deg. C
4.	21.9 deg. C	18.9 deg. C
5.	22.6 deg. C	19.6 deg. C
6.	24.3 deg. C	20.3 deg. C
7.	25.0 deg. C	21.0 deg. C

A1.4 The unit shall start working in cooling mode depending upon the temperatures as under:

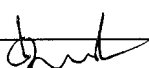

- If the difference of return air temperature and set temperature i.e. return air temperature minus set temperature is negative only blower & exhaust fan will work.
- If the difference of return air temperature and set temperature i.e. return air temperature minus set temperature ≥ 1 to 2°C , condenser fans, one compressor shall work.
- If the difference of return air temperature and set temperature i.e. return air temperature minus set temperature $> 2^{\circ}\text{C}$, condenser fans, both compressors shall work and shall be continued till the temperature of return air reaches 23°C .
- There is a 5 seconds delay between the start times of the first and second compressors for both the unit in a coach.

A1.5 Cooling should not be started under the following conditions:

- AIR-CO switch is turned OFF.
- There is no power supply to condenser, blower fan motor and compressor.
- TOP (Thermal overloading protection) of motors are defective.
- Compressors are tripped from LP/HP or permanently blocked after three successive tripping within one hour.
- All temperature sensors are defective.

A1.6 The condenser fans shall be switched off within 30 seconds in case both the compressors are switched off/tripped due to any reason i.e. cooling shut down period is 30 seconds.

A1.7 In case one condenser motor trips, second condenser fan motor shall immediately start.

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A.2 Normal heating

A.2 The unit shall start working in heating mode depending upon the temperatures as under:

- a) If the difference of set temperature and return air temperature i.e. set temp minus return air temperature is negative only blower & exhaust will be ON.
- b) If the difference of set temperature and return air temperature i.e. Set temp minus return air temperature ≤ 1 , heater will be ON for 5 seconds and OFF for 55 seconds.
- c) If the difference of set temperature and return air temperature i.e. Set temp minus return air temperature > 1 to 3°C , heater will be ON for 30 seconds and OFF for 30 seconds.
- d) If the difference of set temperature and return air temperature i.e. Set temp minus return air temperature $> 3^{\circ}\text{C}$, heater will be ON for 55 seconds and OFF for 5 seconds.
- e) There is a 30 seconds delay between the cycle start time for both heating units provided in both RMPU in a coach.

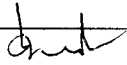
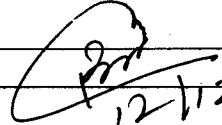
A2.1 Heater should not work under the following conditions:

- a) AIR-CO switch is turned OFF.
- b) If power supply to heater is absent.
- c) Return air/supply air temperature sensors are not working or defective.
- d) Blower fan motors are in tripped condition or not in working.
- e) OHP switches are in tripped condition
- f) Fusible link (ESTI cartridge) is defective or already burst.

NOTE: Before switching on various equipment, the safety devices checks of TOP, HP/LP, pressure control switch OHP, temperature sensors, hygrostat for its healthiness shall be ensured by the microprocessor by means of glowing respective LEDs on controller unit.

B) DEHUMIDIFICATION

B.1 Dehumidification process shall be started, if the relative humidity of return air is more than 60% and the temperature is below cooling set point. During this process one compressor and heater shall be ON, while another compressor and one condenser fan will be in OFF position. The heater will be switched OFF after 3 minutes and will remain OFF for further 5 minutes. After 5 minutes the relative humidity shall again be monitored / checked by hygrostat, if still it is more than 60%, the cycle shall be repeated till the RH reaches up to 60%. It

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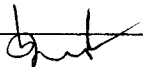
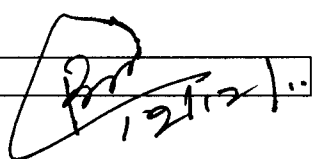
shall be ensured that the return air temperature should not fall below cooling set point.

- B.2 In normal heating mode, if relative humidity is more than 60% and return air temperature falls below heating set point, one compressor and heater shall be ON, while another compressor and one condenser fan will be in OFF position. The heater will be switched OFF after 3 minutes and will remain OFF for further 5 minutes. After 5 minutes, the relative humidity shall again be monitored by hygrostat, if still it is more than 60%, the cycle shall be repeated till the RH is reached up to 60%.
- B.3 ON/OFF status of each equipment shall be indicated on controller unit by means of glowing respective LEDs.
- B.4 Total power consumption of the unit during dehumidification shall not exceed the total power consumption of the unit arrived under cooling capacity test.
- B.5 Dehumidification should not be started under the following conditions and checks for which shall be appeared on display unit:
1. There is no power supply to condenser, blower fan motor, heater and compressor.
 2. TOP of blower motors are defective.
 3. Compressors are tripped from LP/HP or permanently blocked after three successive tripping within one hour.
 4. All temperature sensors are defective.
 5. Hygrostat is defective

NOTE: Before switching on various equipment, the safety devices checks of TOP, HP/LP, pressure control switch OHP, temperature sensors, hygrostat for its healthiness shall be ensured by the microprocessor by means of glowing respective LEDs on controller unit.

EMERGENCY OPERATION OF RMPU

- C.1 The working of blower fans shall be ensured during emergency, if the refrigeration circuit is totally failed for any reason and malfunction with the controller, the blower fan and exhaust fan shall be ON till power supply voltage is available to the blower motor.
- C.2 Under this situation, the fresh air shall be fully closed and the unit shall work on 100% recirculation air. The temperature control of the blower motor shall remain be active.

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D) SAFETY DEVICES OPERATION

1) **Starting of compressors:** Both the compressors shall not be started at a time. First compressor of each unit should be started after 30 seconds from switching ON of AIR-CO switch. Second compressors of the units shall be started after a delay of 5 seconds from start of first compressors, if required.

2) **High Pressure switches:** The compressor should be switched OFF/tripped, if discharge pressure of compressor rises beyond a limit of 425 ± 15 psig. Once the compressor has been switched OFF, it shall not be started before 5 seconds even it is required.

If the compressor tripped three times in one hour, the fault shall be stored/displayed by means of glowing fault indication lamp provided on switch panel, in addition to LED indication.

In case both the compressors of any unit are switched OFF at a time, first compressor shall be started after 30 seconds and other one after 5 seconds from start of first compressor.

The provision shall be there to restart the unit in case both the compressors have tripped three times in one hour.

3) **Low Pressure switches:** The compressor should be switched OFF/tripped, if suction pressure of compressor goes down beyond limit of 35 ± 15 psig. Once the compressor has been switched OFF, it shall not be started before 5 second even it is required.

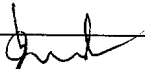
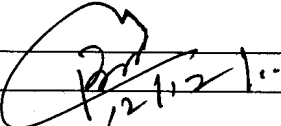
If the compressor tripped three times in one hour, the fault shall be stored/displayed by means of glowing fault indication lamp provided on switch panel, in addition to LED indication.

In case both the compressors of any unit are switched OFF at a time, first compressor shall be started after 30 minutes and other one after 5 seconds from start of first compressor.

The provision shall be there to restart the unit in case both the compressors have tripped three times in one hour.

4) **Control Pressure switch:** Control pressure switches are provided in each circuit to monitor the discharge pressure of compressor. If the discharge pressure is below 275 psig, only one condenser fan will be in working. If the discharge pressure rises above 275 psig, the second compressor shall be started (both condenser fans will run).

5) **Thermal over load protection:** Thermal over load protection devices are embedded in the winding of each motors, which allow to disconnect motor supply through contactor, if the winding temperature of the motor rises

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130°C and shall be automatically re-started when the temperature of the winding comes down. The message shall be displayed by means of LED indication on controller unit.

If it happens three times in one hour, the fault shall be indicated by means of fault indication lamp provided on switch panel in addition to LED indication on controller unit.

(NOTE: The fault indication light provided on switch panel should be reset by turning of AIR-CO switch. The OFF time of motors under this condition shall also be recorded /stored in memory of the controller.)

- 6) **Over heat protection (OHP) for heater:** During heating mode in winter, the overheat protection switch shall take care for excessive heating of supply air. If the supply air temperature reaches beyond the set value i.e. 65°C due to any reason, the OHP will react immediately to disconnect the power supply to the heater through controller and will block the heater working further. The blinking message shall be displayed for the same on display unit. The heating facility shall be available only by re-switch ON of AIR-CO switch. This event shall be recorded/stored in controller memory with the time and at which temperature it has acted.

If for any reason, OHP does not act at 65°C and the temperature rises up to 85°C, the respective contactor of the heater shall be open through microprocessor controller.

- 7) **Shut down of RMPU keeping in view the safety aspect:** The Unit shall automatically be shut down through the microprocessor controller in the following conditions:

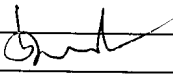
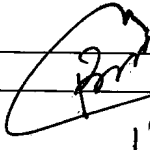
- a) If supply air temperature goes below 5°C
- b) If supply air temperature goes above 85°C

E) MANUAL OPERATION

There shall be the provision for a Rotary switch on the switch board cabinet to switch over the unit in manual mode. In manual mode heater shall be isolated from power supply. The system shall accept an input for the manual mode.

IMPORTANT:

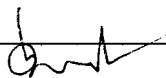
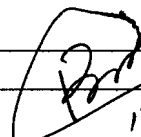
1. The microprocessor controller shall be compatible with NTC sensors & capacitive hygrostat.
2. The return air temperature shall be the average of both side return air temperature being sensed by temperature sensors. In case, any sensor is defective the reading shall be taken from healthy sensor. In case both the sensors have failed, the microprocessor controller will work on the temperature of

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fresh air sensor. Heating mode should not work if all temperature sensors are defective.

3. The ambient temperature shall be the average of both side fresh air temperatures being sensed by temperature sensor. In case, any sensor is defective the reading shall be taken from healthy sensor.
4. The software should be window based and user friendly in common syntax language and should be able to import/export the fault failure reports or data logging reports for further analysis.
5. The storage capacity of events recording shall be of 7 days. At least 2000 faults shall be recorded. The facility for down loading of events and fault through USB drive shall be ensured.

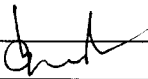
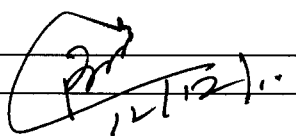
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Annexure - V

LIST OF PROBABLE FAULTS

S.No	Fault	Description
1	LP 1.1 trips	Low pressure limit cross in Unit 1
2	LP 1.2 trips	Low pressure limit cross in Unit 1
3	LP 1.2 trips	Low pressure limit cross in Unit 2
4	LP 2.2 trips	Low pressure limit cross in Unit 2
5	HP 1.1 trips	High pressure limit cross in Unit 1
6	HP 1.2 trips	High pressure limit cross in Unit 1
7	HP 1.2 trips	High pressure limit cross in Unit 2
8	HP 2.2 trips	High pressure limit cross in Unit 2
9	OHP1.1 trips	Over heating protection trips in Unit 1
10	OHP1.2 trips	Over heating protection trips in Unit 2
11	CD 1.1 trips	Condenser motor trips in Unit 1
12	CD 1.2 trips	Condenser motor trips in Unit 1
13	CD 2.1 trips	Condenser motor trips in Unit 2
14	CD 2.2 trips	Condenser motor trips in Unit 2
15	CP 1.1 trips	Compressor motor trips in Unit 1
16	CP 2.1 trips	Compressor motor trips in Unit 1
17	CP 1.2 trips	Compressor motor trips in Unit 2
18	CP 2.2 trips	Compressor motor trips in Unit 2
19	HTR1.1 trips	Heater trips in Unit 1
20	HTR 1.2 trips	Heater trips in Unit 2
21	CDT 1.1 trips	Condenser motor TOP trips in Unit 1
22	CDT 1.2 trips	Condenser motor TOP trips in Unit 1
23	CDT 2.1 trips	Condenser motor TOP trips in Unit 2
24	CDT 2.2 trips	Condenser motor TOP trips in Unit 2
25	BLRT 1.1 trips	Blower motor TOP trips in Unit 1
26	BLRT 2.1 trips	Blower motor TOP trips in Unit 1
27	*BLRT 1.2 trips	Blower motor TOP trips in Unit 1
28	*BLRT 2.2 trips	Blower motor TOP trips in Unit 2
29	RT 1.1 fails	Return air temperature sensor fails (Open/short)in Unit 1)
30	RT 1.2 fails	Return air temperature sensor fails (Open/short)in Unit 2)
31	ST 1.1 fails	Supply air temperature sensor fails (Open/short)in Unit 1)
32	ST 1.2 fails	Supply air temperature sensor fails (Open/short)in Unit 2)
33	AT 1.1 fails	{{(Ambient temperature sensor fails (Open/short)in Unit 1)}}
34	AT 1.2 fails	{{(Ambient temperature sensor fails (Open/short)in Unit 2)}}
35	ALLT 1	{All temperature sensors fails(Open/short)}
36	HU 1	Humidity sensor fails in unit 1
37	HU 2	Humidity sensor fails in unit 2
38	SV	400 V not received

* In case two blower motors are used.

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Chief Electrical Service Engineer

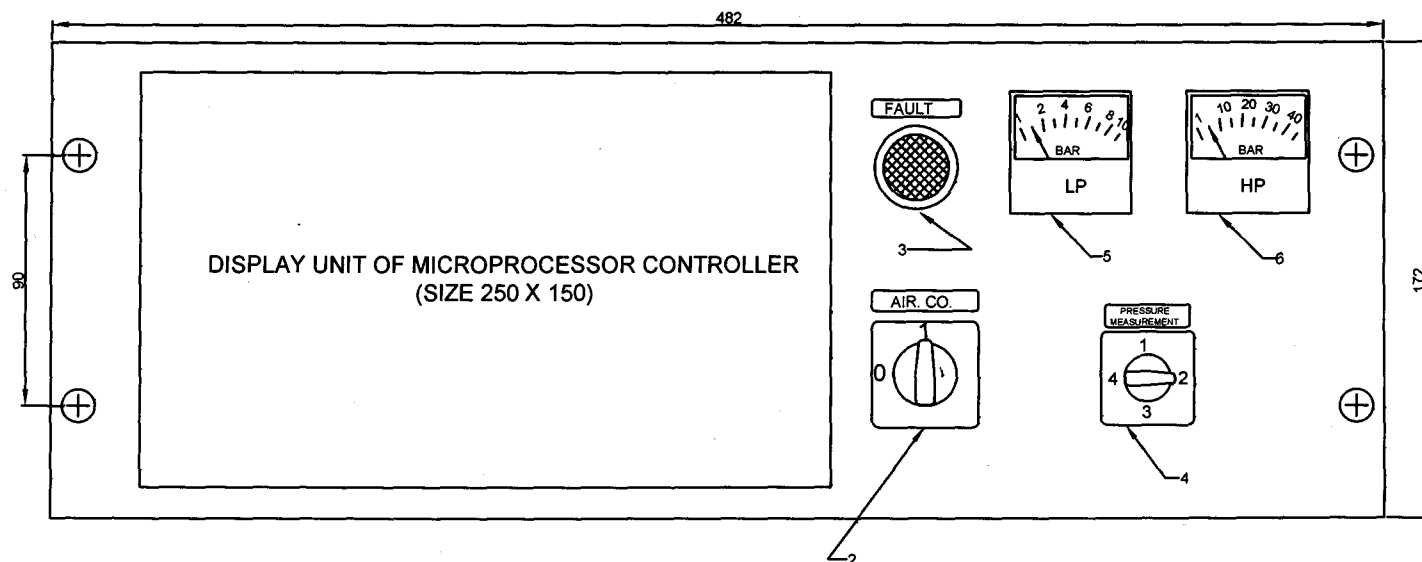
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• Eastern Railway, Fairlie Place, Kolkata - 700 001	• पूर्व रेलवे फेयरली प्लेस, कोलकाता-700001
• Northern Railway, Baroda House, New Delhi-110 001	• उत्तर रेलवे, बड़ौदा हाउस, नई दिल्ली-110001
• Central Railway, Parcel office, CST, Mumbai CST - 400 001	• मध्य, रेलवे मुंबई सीएसटी-400 001
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• North Central Railway, Subedarganj, Allahabad-211033	• उत्तर मध्य रेलवे, सुबेदारगंज, इलाहाबाद-211033
• Western Central Railway, Jabalpur-482 001	• पश्चिम मध्य रेलवे, जबलपुर-482001
• East Central Railway, Dighi, Distt- Vashali, Hajipur, Bihar-844 101	• पूर्व मध्य रेलवे दिघी जिला वैली हाजीपुर बिहार -844101
• North Western Railway, Jaipur 302006	• उत्तर पश्चिम रेलवे, जयपुर-302006
• South Western Railway, 4 th Floor, DRM office, Sh Laxmi Narayan Complex, Station Road, Hubli, - 580020	• दक्षिण पश्चिमी रेलवे, चौथी तल, डी0आर0एम0 कार्यालय श्री लक्ष्मी नारायण कामप्लेक्स स्टेशन रोड हुबली-580 020
• South East Central Railway, Bilaspur-495004	• दक्षिण पूर्व मध्य रेल, बिलासपुर-495 004
• East Coast Railway, Bhuvneshwar Orrisa-751 016	• पूर्वोत्तर रेलवे, भुवनेश्वर उड़ीसा -751 016
Konkan Railway, Belapur Bhawan, Sector-11, Belapur, Mumbai - 400 614	• कोणकन रेलवे, बेलपुर भवन, सेक्टर-11, बेलपुर मुंबई-400 614
• Integral Coach Factory, Chennai.-600038	• सवारी डिब्बा कारखाना, चेन्नई-600 038
• Rail Coach Factory, Hussainpur, Kapurthala-144 602	• रेल डिब्बा कारखाना, हुसैनपुर, कपूरथला -144 602

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Checked by

12/12/11

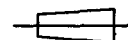


NOTE :

1. ALL DIMENSIONS ARE IN MM.
2. THE MATERIAL USED IN THE PANEL SHALL BE FIRE RETARDANT.
3. THE MOUNTING HOLES SHALL BE STRICTLY MAINTAINED. THE OVERALL DIMENSIONS CAN SLIGHTLY BE INCREASED TO ACCOMMODATE THE DISPLAY UNIT AND OTHER COMPONENTS VALIDATED FROM RCF/ICF.
4. SWITCH PANEL SHALL BE EARTHED WITH COACH BODY.
5. ELECTRICAL WIRE SHOULD NOT BE IN HANGING POSITION. THE TERMINAL BLOCKS SHOULD BE DIN RAIL MOUNTED FROM INSIDE.
6. THE DISPLAY UNIT TO BE MOUNTED IN THE PANEL SHALL BE AS PER RDSO SPEC. NO. RDSO/PE/SPEC/AC/0139-(REV.1)-2009.
7. PANEL SHALL BE MADE WITH SS SHEET S2 GRADE 304 TO IS:6911.

	6.	HP PRESSURE GAUGE	1			
	5.	LP PRESSURE GAUGE	1			
	4.	SWTCH 1 POLE, 4 POSITION, 110 V DC/5 mA	1			
	3.	110 V DC	1			
	2.	SWTCH 1 POLE, 2 POSITION, 110 V DC/5 mA	1			
	1.	DISPLAY UNIT OF MICROPROCESSOR CONTROLLER	1			
REF. NO.	PART NO.	DESCRIPTION	DETAIL DRG. NO.	NO. OFF	MATL.	SPEC. NO.

REF.: RCF DRG. No.SKED 502



SCALE : NTS

APPROVED BY

FOR DG

**SWITCH PANEL FOR RMPU
(LHB & DOUBLE DECKER AC COACHES)**

FIRST ISSUED

SUPERSEEDS

RDSO/PE/SK/AC/ 0125 - 2009 (REV. 1)

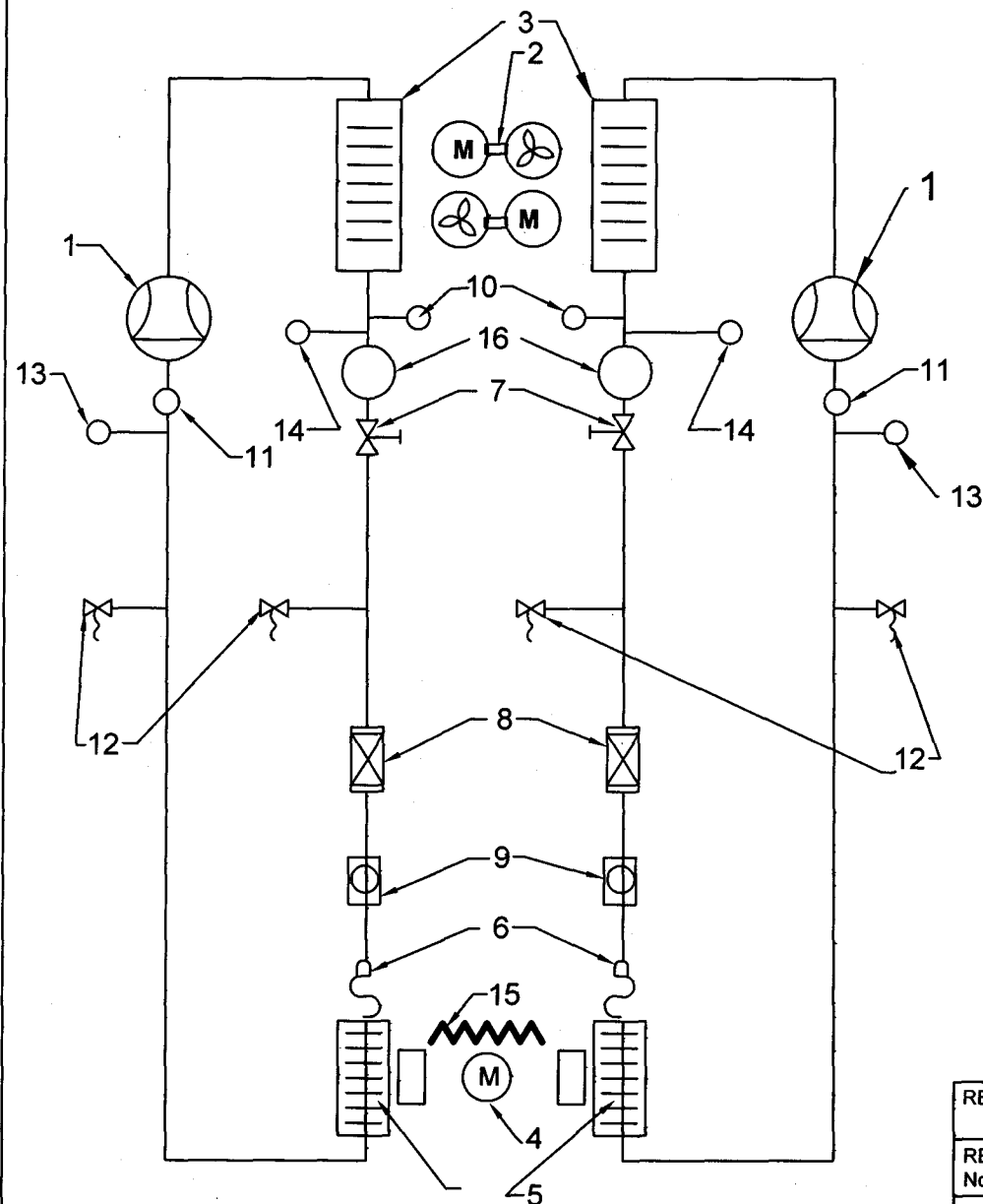
SUPERSEDED BY

CHANGES IN REVISED DRAWING

NOTE CORRECTED AND SOME ADDITIONAL NOTE ADDED. TITLE CHANGED

DT	NOV.11
D	MS
C	

REF. NO.	PART NO.	DESCRIPTION	QTY. IN DETAIL	NO. OFF	MATL.	SPEC.
REF. NO.			SCALE: 1/8" = 1'-0"	APPROVED:		FOR:
<p align="center">ROOF MOUNTED GATE PACKAGE UNIT FOR LHB VARIANT AC COACHES (GENERAL ARRANGEMENT & DIMENSIONAL REQUIREMENTS)</p> <p align="center">RDSO/PE/SK/AC/0069 - 2004 (REV.'1')</p>						
DATE						PARTS USED: SUPPLEMENTED REV. A BY: SUPERSEDED:



1. COMPRESSOR : 2 NOS.
2. CONDENSER FANS & MOTORS : 2 NOS. EACH
3. CONDENSER COILS : 2 NOS
4. SUPPLY AIR FANS & MOTOR : 2 & 1 NOS
5. EVAPORATOR COILS : 2 NOS.
6. EXPANSION VALVE & DISTRIBUTOR : 2 NOS
7. SHUTOFF VALVE : 2 NOS (ONE IN EACH REF. CIRCUIT)
8. FILTER DRIER : 2 NOS.(ONE IN EACH REF. CIRCUIT)
9. CONTROL PRESSURE SWITCH : 2 NOS.(ONE IN EACH REF. CIRCUIT)
10. HIGH PRESSURE SENSOR : 2 NOS (ONE IN EACH REF. CIRCUIT)
11. LOW PRESSURE SENSOR : 2 NOS (ONE IN EACH REF. CIRCUIT)
12. FILLING VALVE : 2 NOS (ONE IN EACH REF. CIRCUIT)
13. PRESSURE TRANSDUCER (LP) : 2 NOS (ONE IN EACH REF. CIRCUIT)
14. PRESSURE TRANSDUCER (HP) : 2 NOS (ONE IN EACH REF. CIRCUIT)
15. HEATER ASSEMBLY ALONGWITH, DOUBLE PROTECTION : 1 NO.
16. LIQUID RECIEVER: 2 NOS (ONE IN EACH REF. CIRCUIT)
17. ACCUMULATOR (OPTIONAL) : 2 NOS (ONE IN EACH REF. CIRCUIT)

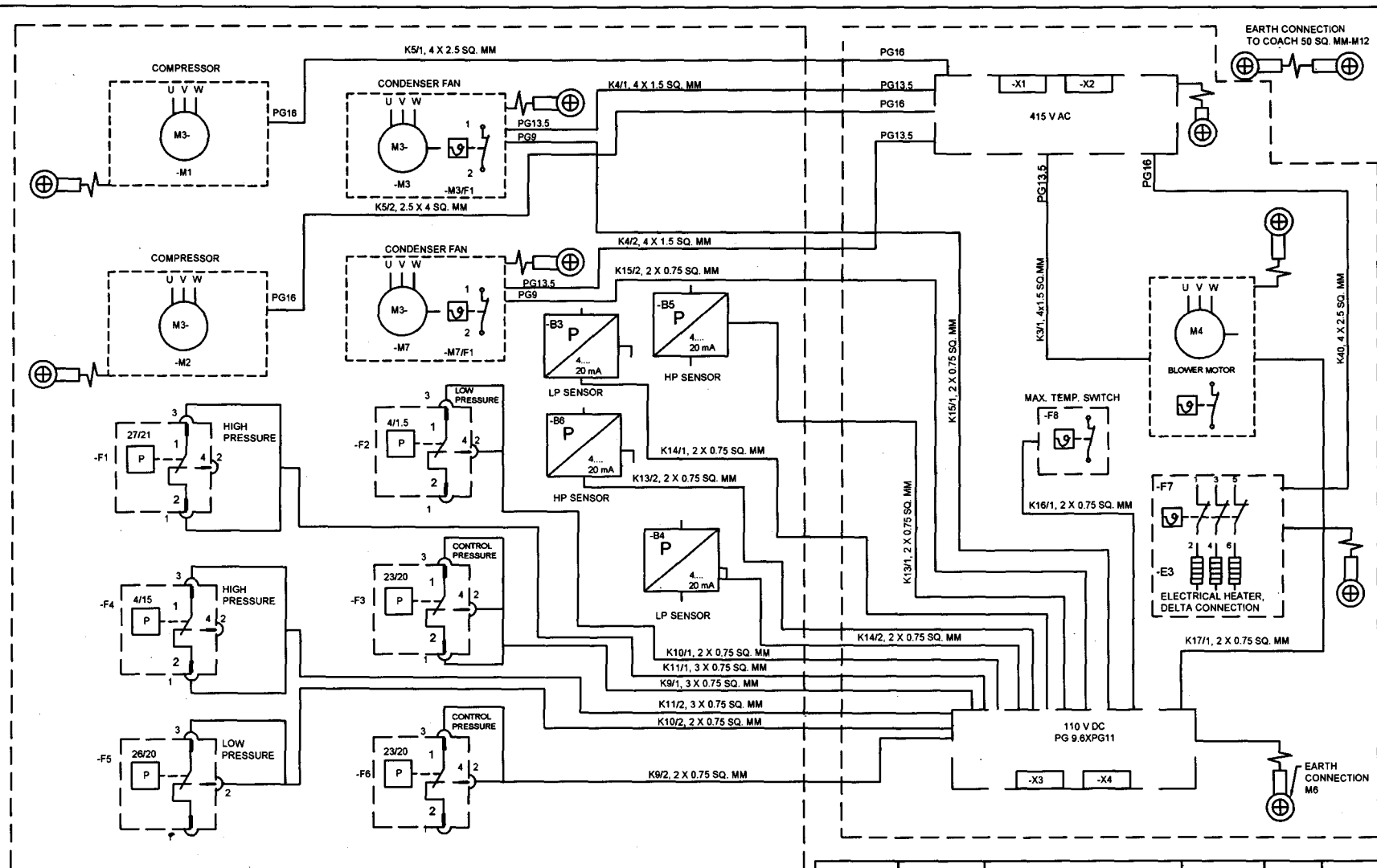
DT.	OCT.11
D	MS
C	

CHANGES DONE IN REVISED DRAWING


HOT GAS BYPASSED, ALL SOLENOID VALVE, SCHRADER VALVE DELETED AND EXPANSION VALVE ADDED. NUMBERING CORRECTED

STATUS	ALT./REV	REF. No.	DESCRIPTION	APPD.	DATE

REF. No.	PART No.	DESCRIPTION	DETAIL DRG. No.	No. OFF	MATL.	SPEC.
REF.:HFG DRG. No.S65F250.000-00A.Z3		SCALE : NTS	APPROVED			FOR DG
AIR-CONDITIONING SYSTEM FOR RMPU (LHB VARIANT AC COACHES)					FIRST ISSUED	
RDSO/PE/SK/AC/0071 - 2004 (REV.1)					SUPERSEEDS	
					SUPERSEDED BY	



- NOTES :**
1. THE CABLE FOR POWER SHALL BE AS PER RDSO SPEC. NO. RDSO/SPEC/ELC/0019-2002 (LATEST) AND SHALL BE OF RDSO APPROVED MAKE.
 2. THE CABLE FOR CONTROL SHALL BE AS PER JSS 50134 AND SHALL BE OF RDSO APPROVED MAKE.
 3. ALL THE CABLE SHALL BE ROUTED THROUGH NON-METALLIC CONDUIT, IF SHEATHED CABLES NOT USED.
 4. NON-METALLIC CONDUIT SHALL BE AS PER IEC 61386-1.
 5. M6 & M12 SIZE CRIMPING SOCKET FOR EARTH CONNECTION SHALL BE USED FOR EQUIPMENT & COACH RESPECTIVELY. EARTHING BUSH SHALL BE MADE ON THE UNIT.

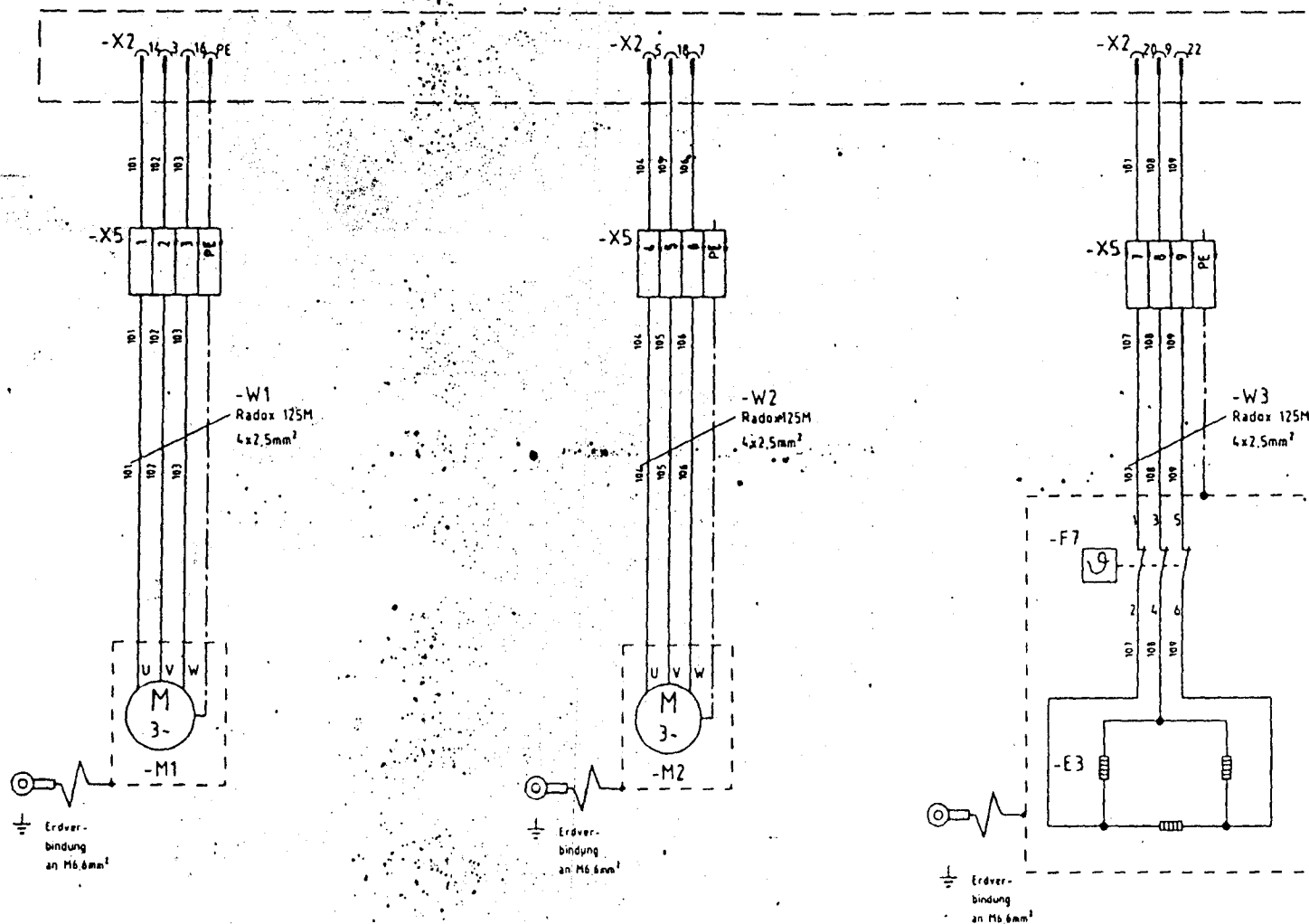
REF. No	PART No.	DESCRIPTION	DRG No. DETAILS	No. OFF	MATL.	SPEC.
REF.:DRG. No. S65F-100.900-00A.V3			SCALE : NTS	APPROVED BY		
			FOR DG			
WIRING DIAGRAM OF RMPU (LHB VARIANT AC COACHES)				FIRST ISSUED		
				SUPERSEDS		
				SUPERSEDED BY		
RDSO/PE/SK/AC/0072 - 2004 (REV.'1')						

DT.	OCT. 11
D	MS
C	

CHANGES IN REVISED DRAWING
ALL SOLENOID VALVES, CRANKCASE HEATER, SURVO MOTOR & THEIR WIRES DELETED.

STATUS	ALT.	REF. NO.	DESCRIPTION	APPD.	DATE

compressor unit 1.1	compressor unit 1.2	el. heater unit 6KW, 415VAC
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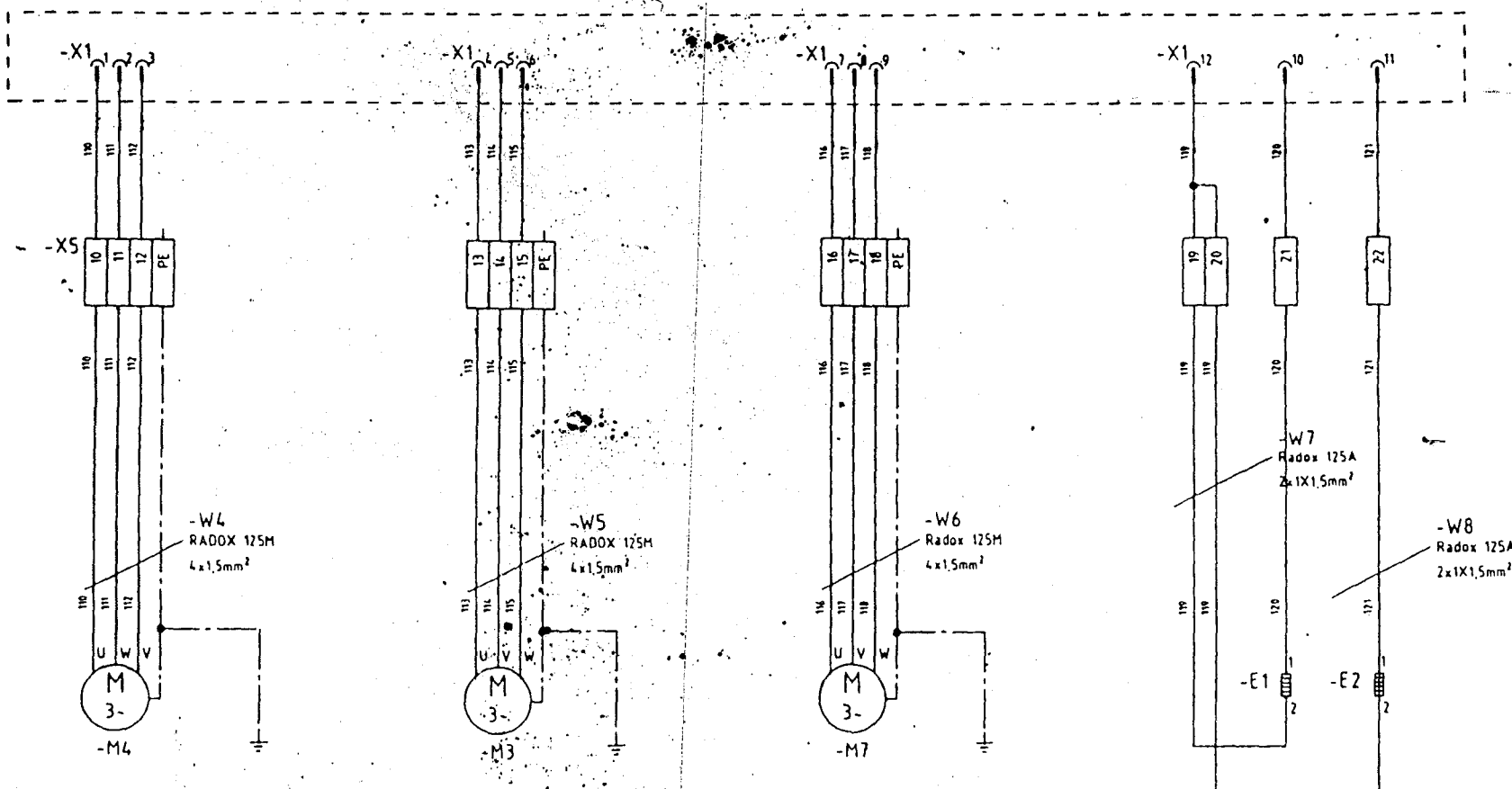
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Drawn with ELCAD (R)

all wiring without marking are the size of mm²

850471	26.08.98	Wi.	Date	14.05.1998	LHB	<F> HFG	Stromlaufplan HVAC System Indian Railways Kompakt Unit	I.Nr. 9582223	
850397	23.06.98	Wi.	Drawn	H.-G. Will					
850358	10.06.98	Wi.	Appr.	Schwardmann					
Ch. 3100	Date	Name	Norm	Rohland	take place of	replacement for	origin	S65F-100.900-00A.54	Page 1 1 Pg

ventilation fan unit 1	condenser fan 1	condenser fan 2	crankcase heater compressor unit 1.1	crankcase heater compressor unit 1.2
supply air fan				



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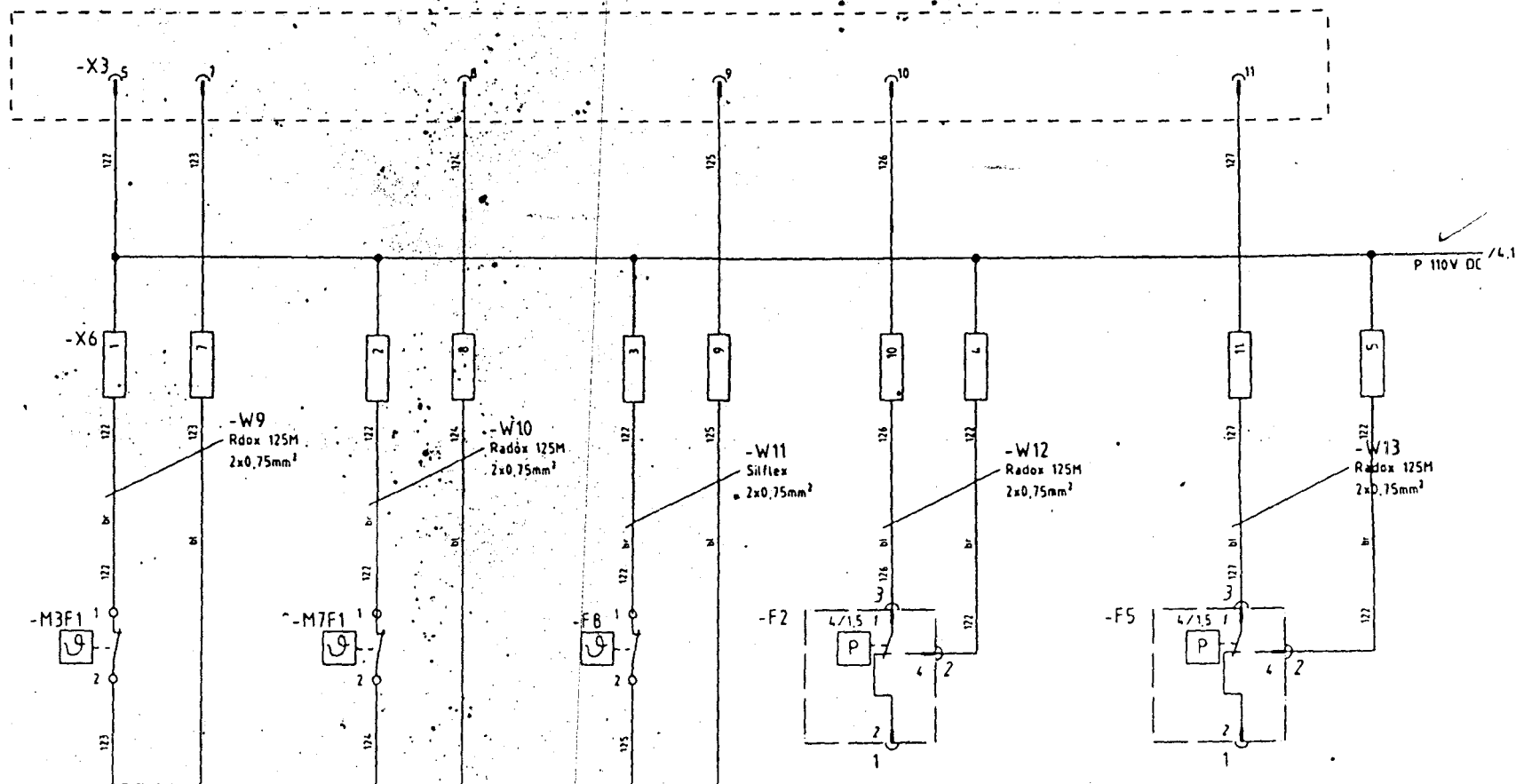
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Drawn with ELCAD (R)

all wiring without marking are the size of mm²

BS0471	28.8.98	Wi	Date	14.05.98	LHB	<F> HFG	Stromlaufplan HVAC System Indian Railways Kompact Unit	I.Nr. 9582223	.S65F-100.900-00A.S4	Page 2 1 Pg
BS0397	23.06.98	Wi	Drawn	M.-G. Wilt						
BS0359	10.06.98	Wi	Appr.	Schwardtmann						
Change	Date	Name	Norm	Revised	Take place of:	replacement for:	origin	H.-G. Wilt		

temperature switch motor protection condensor fan 1	temperature switch motor protection condensor fan 2	max. temperature switch	low pressure switch unit 1.1	low pressure switch unit 1.2
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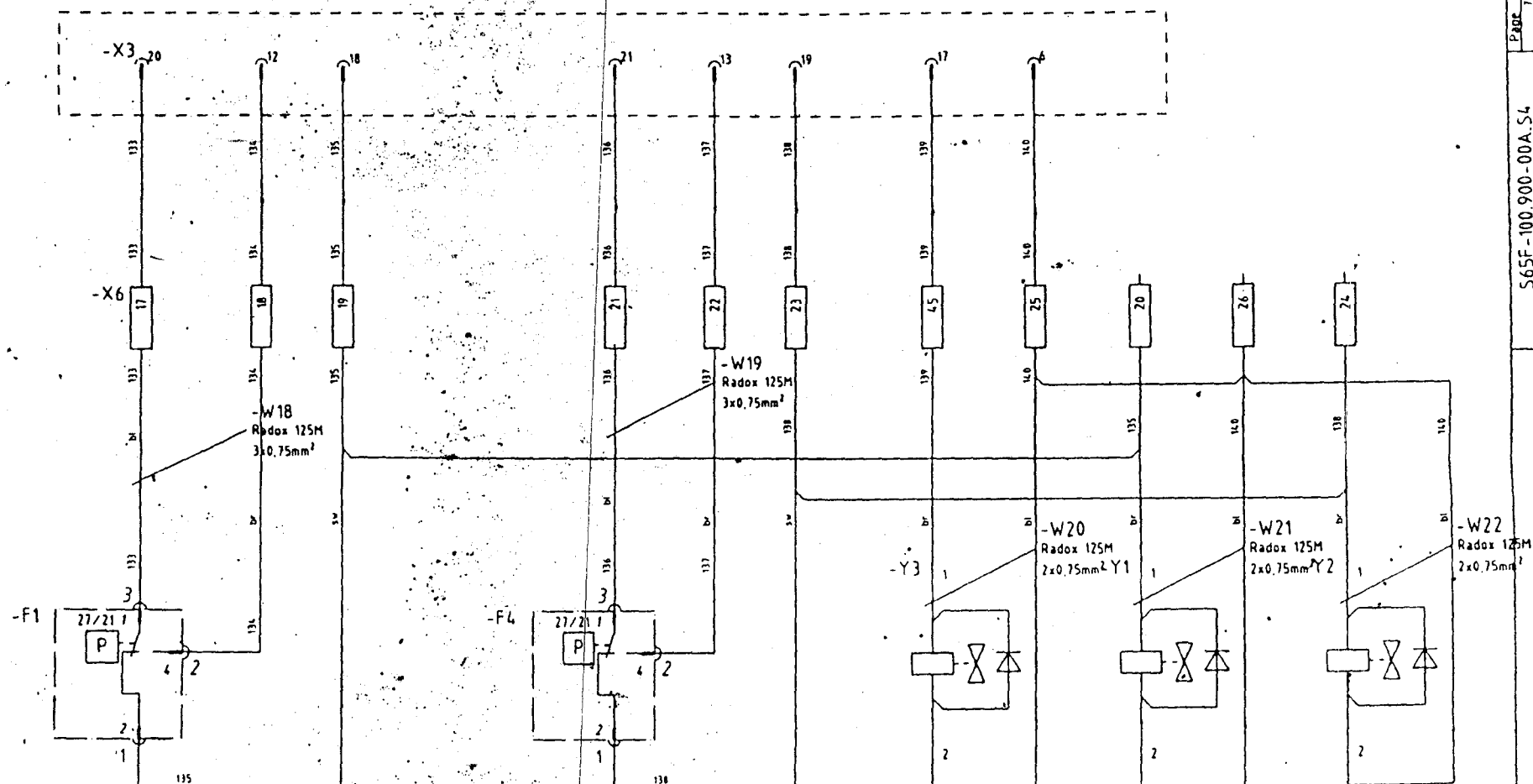
Drawn with EICAD (R)

at wiring without marking are the size of mm²

850471	24.08.98	W.	Date	14.05.1998	LHB	<F> HFG	Stromlaufplan HVAC System Railways Kompakt Unit	I.Nr. 9582223	Page 3 7 Pg
850359	10.06.98	W.	Appr.	Schuster/MJM	take place of:	replacement for:	origin:	565F-100,900-00A.S4	
Change	Date	Name	Norm	Rehland					

Page 3
7 Pg
S65F-100,900-00A.S4

high pressure switch	high pressure switch	solenoid valve 110VDC by-pass 1.1	solenoid valve 110VDC compressor unit 1.1	solenoid valve 110VDC compressor unit 1.2
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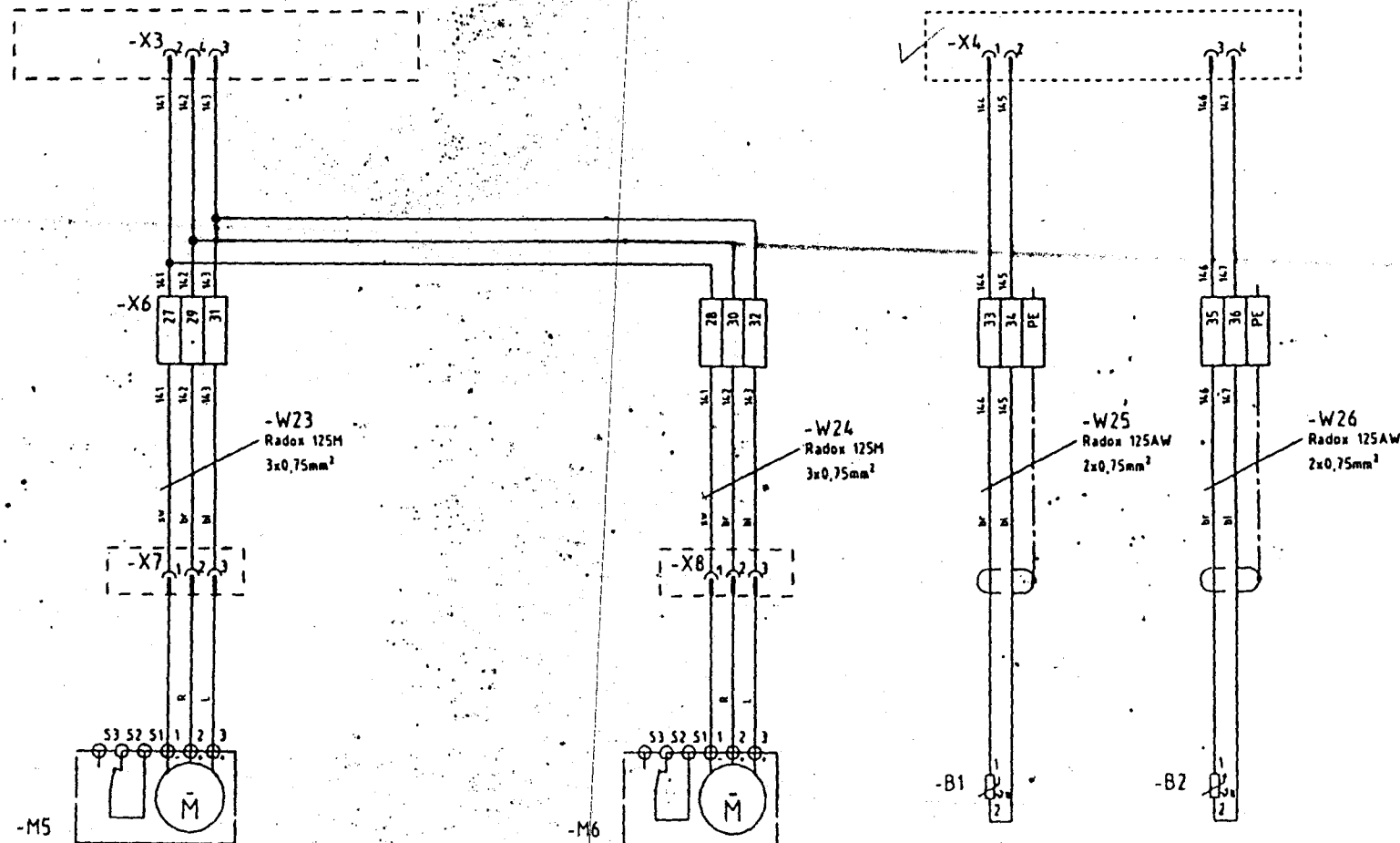
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Drawn with ELCAD (R)

at wiring without marking are the size of mm²

8504.71	26.08.98	Wi.	Date	14.05.1998	LHB	<F> HFG	Stromlaufplan HVAC System Indian Railway's Kompakt unit	I.Nr.9582223	Page 5 1Pg.
850359	10.06.98	Wi.	Appr.	Schwardlmann					
Change	Date	Name	Norm	Ratland	take place of	replacement for	origin	S65F-100.900-00A.S4	

return - air flap unit 1	servomotor 24VDC/8W	temperatur sensor ,Ntc	temperatur sensor ,NTE
		outside air	duc air



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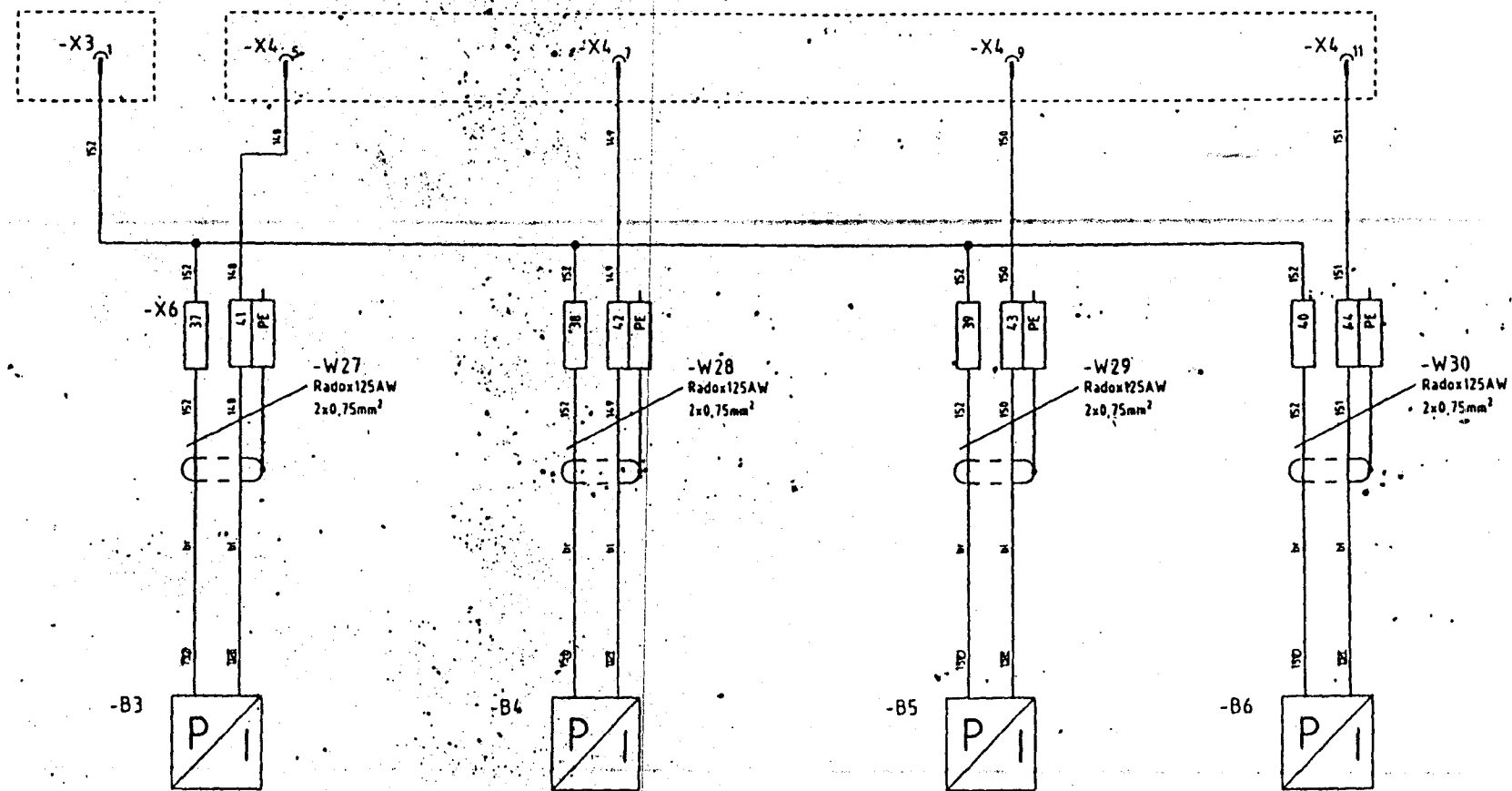
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Drawn with ELCAD (R)

all wiring without marking are the size of mm²

050471	26.08.98	WL	Date	14.05.1998	LHB	<F> HFG	Stromlaufplan HVAC System Indian Railways Kompakt Unit	I.Nr. 9582223	
050397	23.08.98	WL	Drawn	M.-G. Will					
Change	Date	Name	Norm	Approved	Take place of:	Replacement for:	Origin:	S65F-100.900-00A.54	Page 4 1 Pg.

transducer (low pressure) unit 1.1 transducer (low pressure) unit 1.2 transducer (high pressure) unit 1.1 transducer (high pressure) unit 1.2



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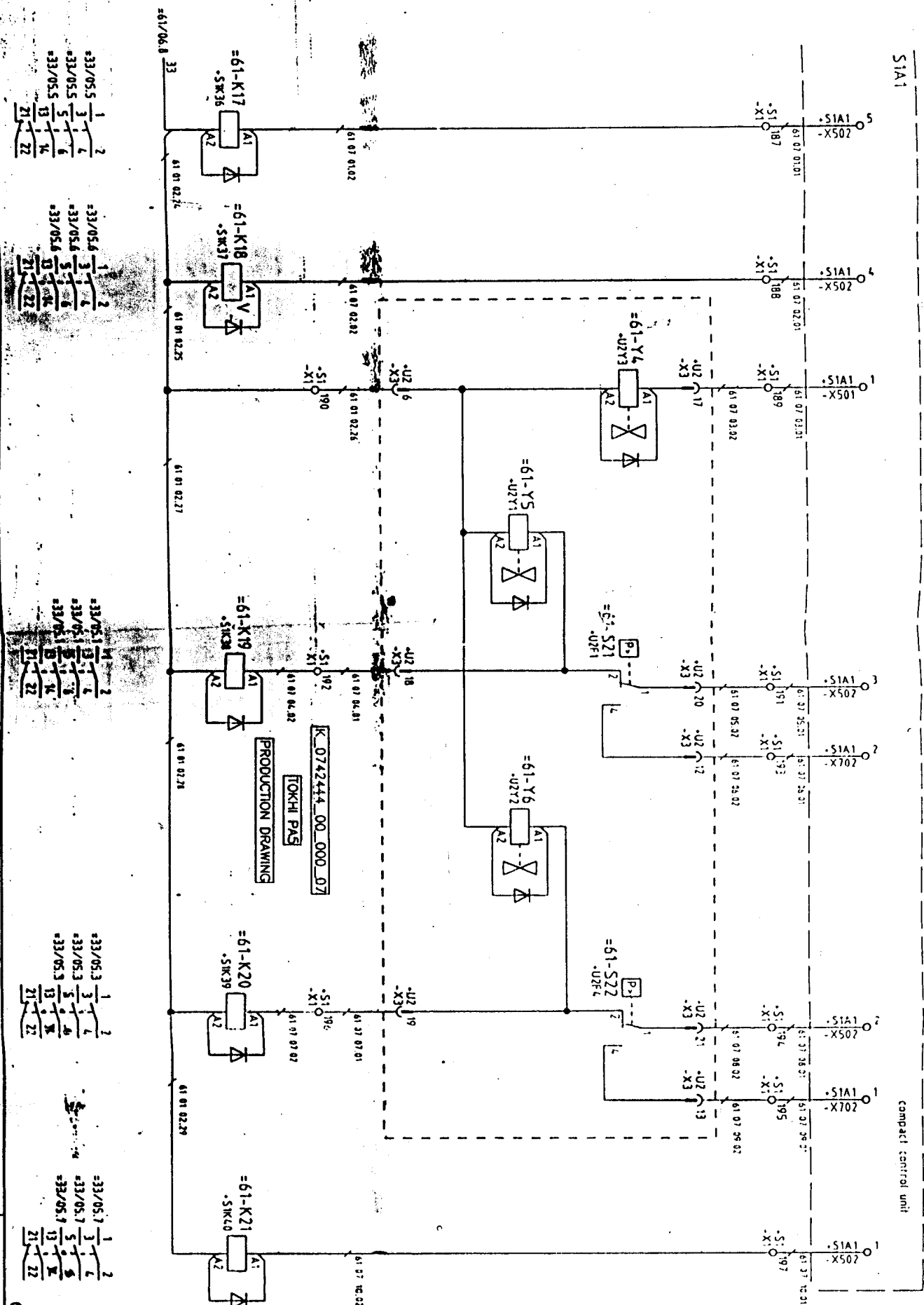
Drawn with ELECAD (R)

at wiring without marking are the size of mm²

850471	26.08.98	WL	Date	14.05.1998	LHB	<F> HFG	Stromlaufplan HVAC System Indian Railways Kompakt Unit	I.Nr. 9582223	
850397	23.06.98	WL	Drawn	H.-G. Witt					
850359	10.06.98	WL	Appr.	Schwardmann					
Change	Date	Name	Norm	Rehland	Take place of:	replacement for:	origin		

S65F-100.900-00A.S4

SCHUTZVERMERK NACH DIN 34 BEACHTEN
PROTECTION MARK DIN 34-1-E



0742444

condenser fans unit 1

bypass 1.1

solenoid valve

compressor unit 1.1

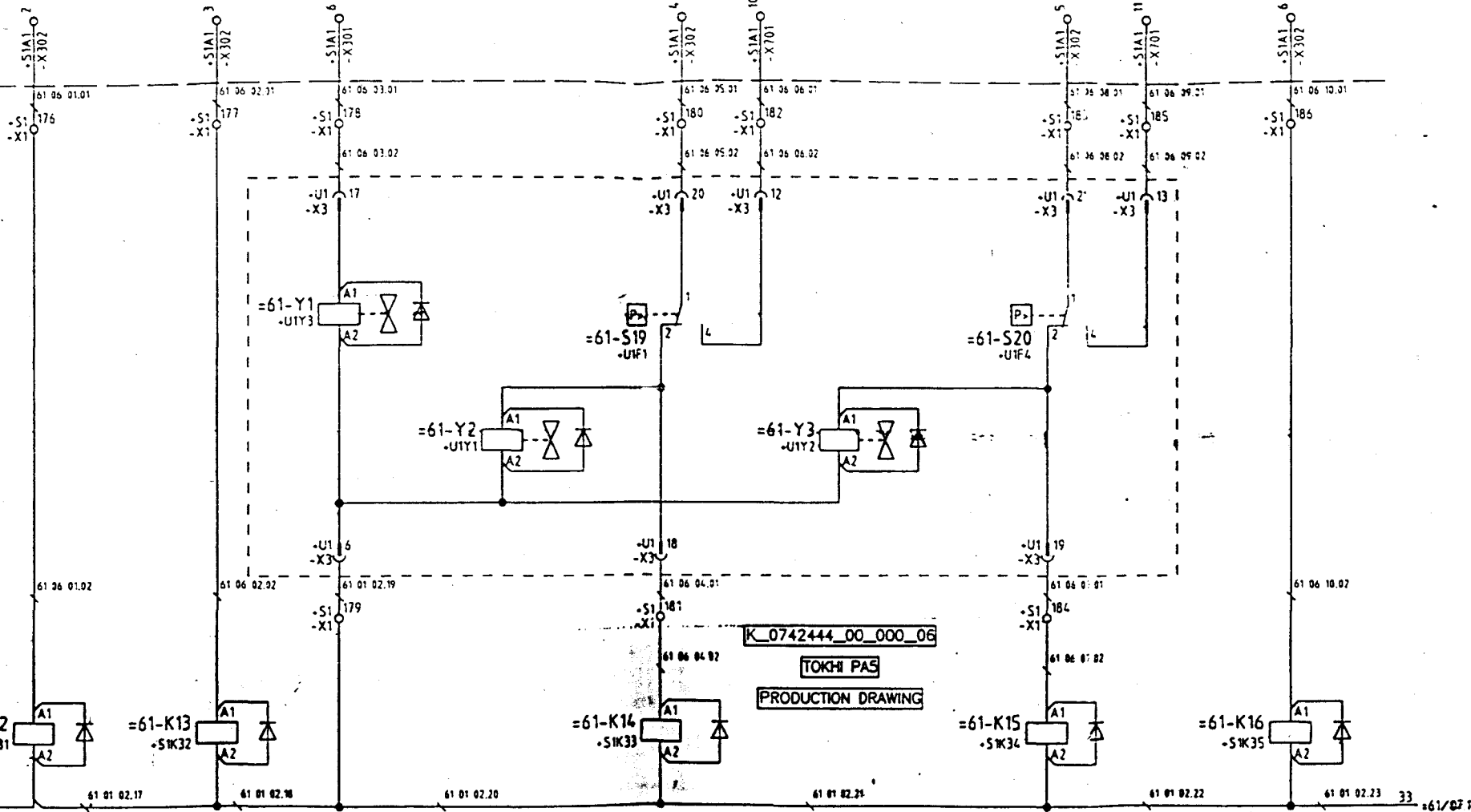
solenoid valve

compressor unit 1.2

el. heater unit 1

compact control unit

S1A1



33/04.5	1	2
33/04.5	3	4
33/04.5	5	6
33/04.5	13	14
33/04.5	21	22

33/04.6	1	2
33/04.6	3	4
33/04.6	5	6
33/04.6	13	14
33/04.6	21	22

33/04.2	1	2
33/04.2	3	4
33/04.2	5	6
33/04.2	13	14
33/04.2	21	22

33/04.3	1	2
33/04.3	3	4
33/04.3	5	6
33/04.3	13	14
33/04.3	21	22

33/04.7	1	2
33/04.7	3	4
33/04.7	5	6
33/04.7	13	14
33/04.7	21	22

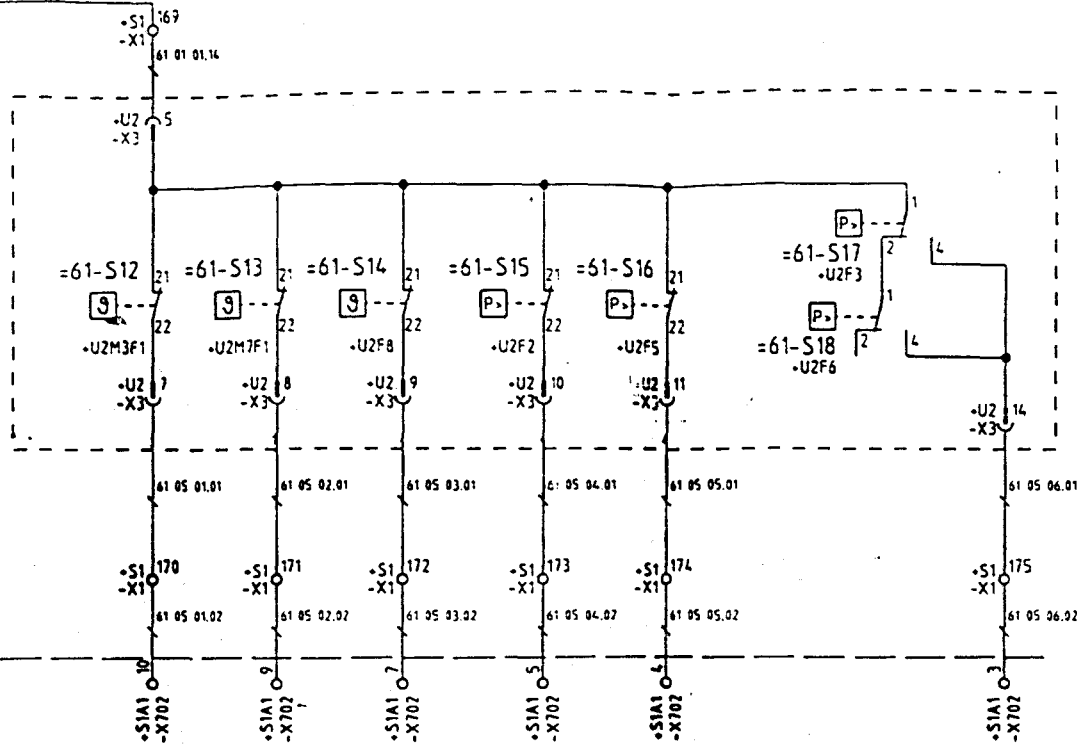
0742444

SCHUTZVERMERK NACH DIN 34 BEACHTEN
PROTECTION MARK DIN 34-1-E

24	emission 01	03.99	sch	Date	01.9.1997	use for	AML/HSC	INDIAN RAILWAYS	SCHALTBAU AG	air condition control	
25	emission 02	03.99	sch	Drawn	sch						
26	emission 03	03.99	sch	Checked	sch						
27	emission 04	03.99	sch	Approved	sch						

emergency vent.

61/04.8 32



compact control unit

S1A1

K_0742444_00_000_05

TOKHI PAS

PRODUCTION DRAWING

SCHUTZVERMERK NACH DIN 34 BEACHTEN
PROTECTION MARK DIN 34-1-E

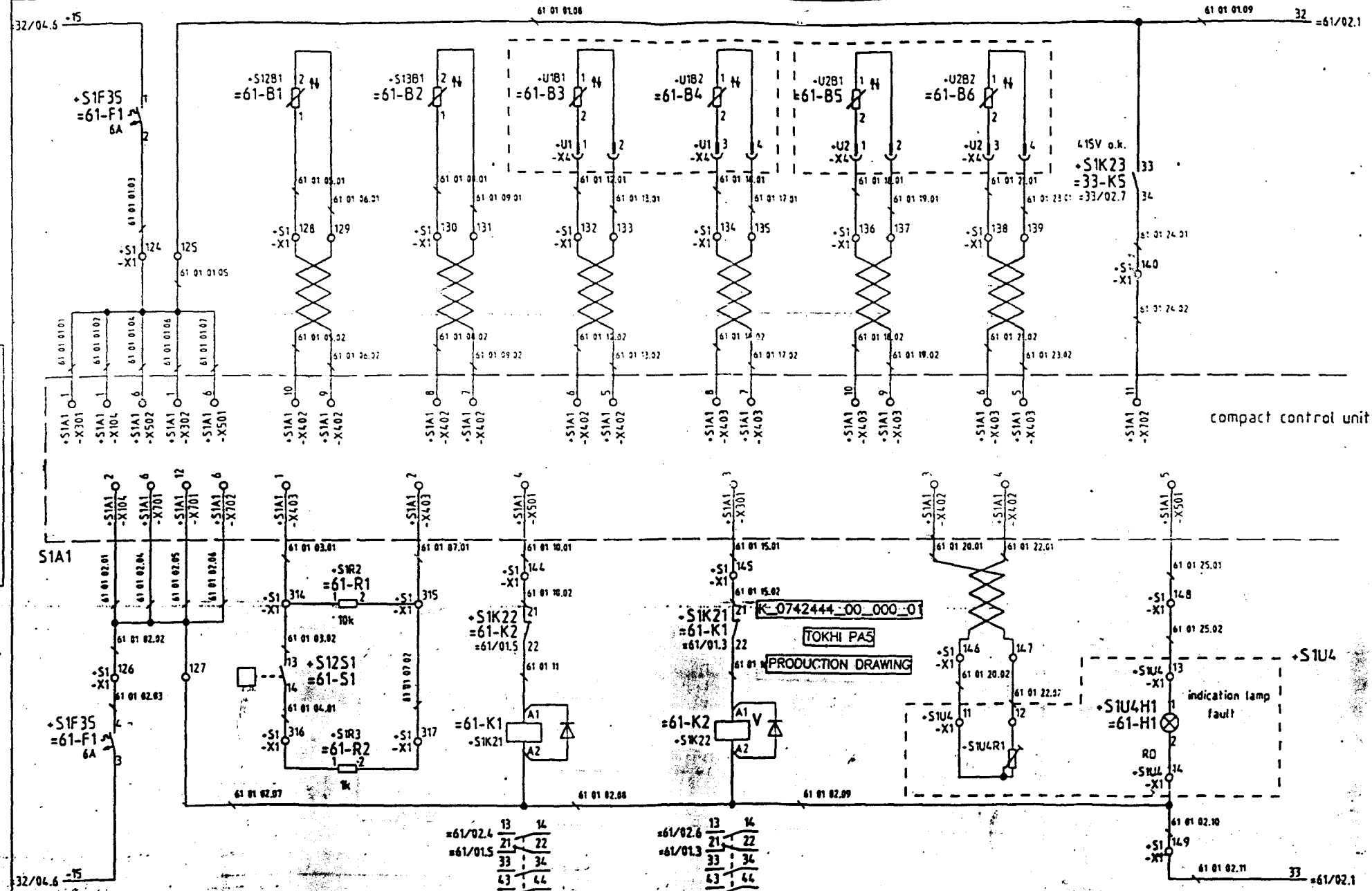
emission 01	03.99	sch	Date	01.9.1997	use for	INDIAN RAILWAYS	SCHALTRAG	air condition control	0742444
Drawn	sch	sch	Drawn	sch	sch	INDIAN RAILWAYS	SCHALTRAG	air condition control	0742444
Checked	sch	sch	Checked	sch	sch	INDIAN RAILWAYS	SCHALTRAG	air condition control	0742444
Take the place of	sch	sch	Take the place of	sch	sch	INDIAN RAILWAYS	SCHALTRAG	air condition control	0742444
replacement for	sch	sch	replacement for	sch	sch	INDIAN RAILWAYS	SCHALTRAG	air condition control	0742444
for	sch	sch	for	sch	sch	INDIAN RAILWAYS	SCHALTRAG	air condition control	0742444

[illegible]

passenger compartment

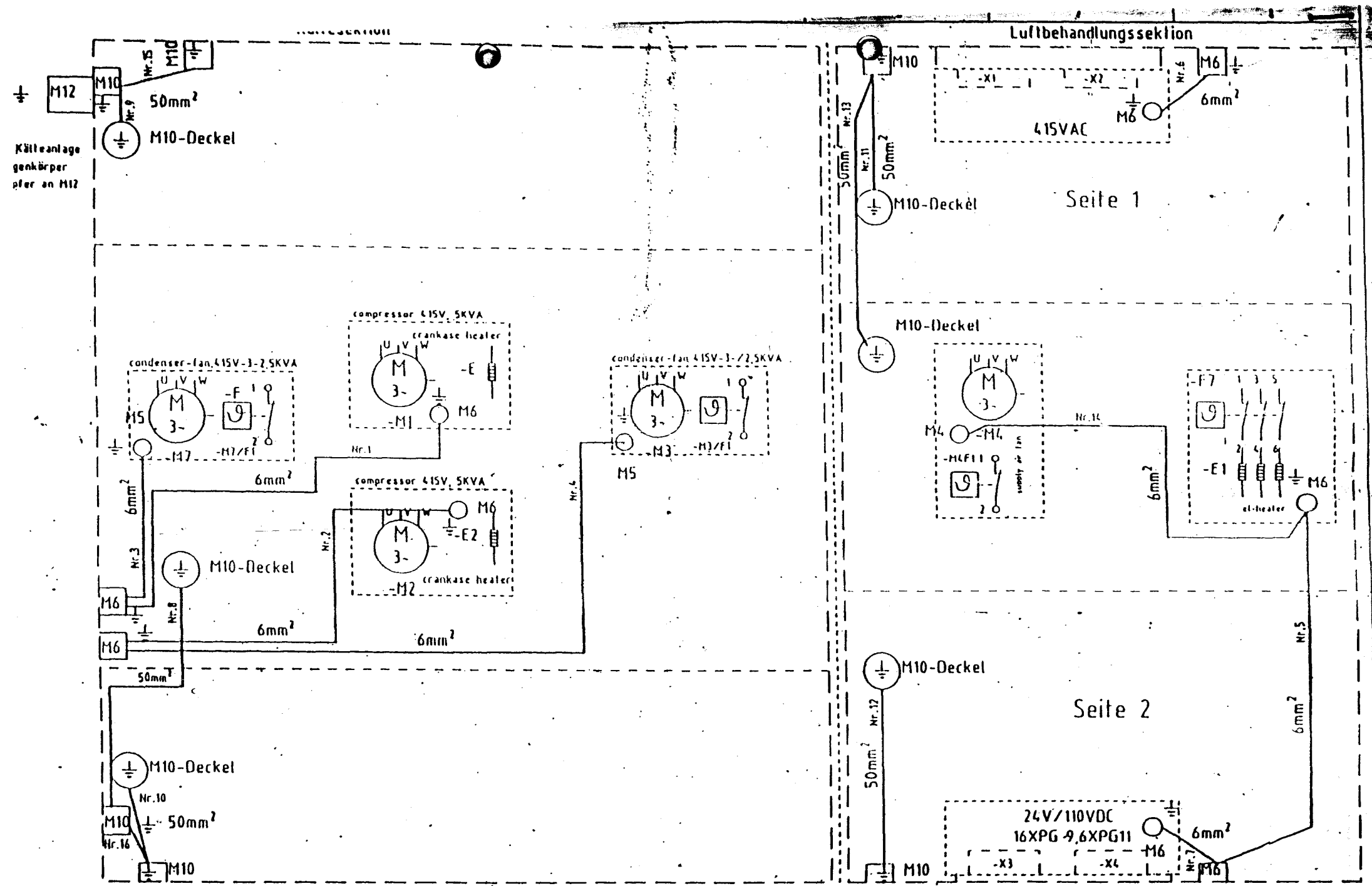
temperature sensors
outside air

duct air

SCHUTZVERMERK NACH DIN 34 BEACHTEN
PROTECTION MARK DIN 34-1-E

compact control unit

0742444



LEAD (R)

Datum 23.07.98		LHB		<F> HFG		Erdungsplan		LNr. 9583580	
Bearb. H. G. Will						HVAC System Indian Railways			
26.08.98	Wl.	Gepr.	Schwardmann			Kompact Unit		S65F-100.931-13A.24	
Datum	Name	Norm	Rehland	Ersatzg. durch	Ersatzg. durch	Ursprung		Blatt 1	

Blatt 1
1 Bl.