#138914

ERL MAINTENANCE SUPPORT SDN BHD

(Company No. 498574-T)

E-MAS

Effective Railway Operations; Reliable System Maintenance

PROJECT & ENGINEERING DEPARTMENT

Richard Murgenthal's VCB Replacement Guideline

Ref. No. G00.OMD.M92020.PE.1001.A

Release

Released:	Jayarajah Savarimuthu	Rolling Stock & Engineering	25.4.18	
Checked:	David Thiagarajan	Quality, Environment & Documentation	24.4.18	
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Checked:	Dzulfaqar Yusoff	Project & Engineering	23/4/18	
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	Name	**Dept.**	**Date**	**Signature**

Amendments or additions to this procedure must be indicated with a vertical black line in the adjacent left margin.

Change Record and Configuration Control

A	3 Apr 18	New	Amir Nordin
Revision	**Date**	**Modification**	**Name**

Planning Of Changes Reference For Revision: G00.OMD.M92020.PE. 1001.A					
Issues To Consider	**Checked** *(Please mark X)*				**Remarks**
1) Are there any negative impact?	YES		NO		Not applicable, new procedure
2) Will the integrity of QEMS be affected?	YES		NO		
3) Resources available?	YES		NO		
4) Allocation or relocation of responsibilities and authorities required?	YES		NO		

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1 Purpose

The purpose of this document as a guideline for RST to carry out installation, testing and commissioning the Vacuum Circuit Breaker model no. JR 100561 – 202 by Richard Murgenthal as replacement to Alstom model no. TRK5470971202.

The product trial has been tested at Q11 location. Therefore, this guideline only reflects the comparison, modification instruction and test result for Q11 location.

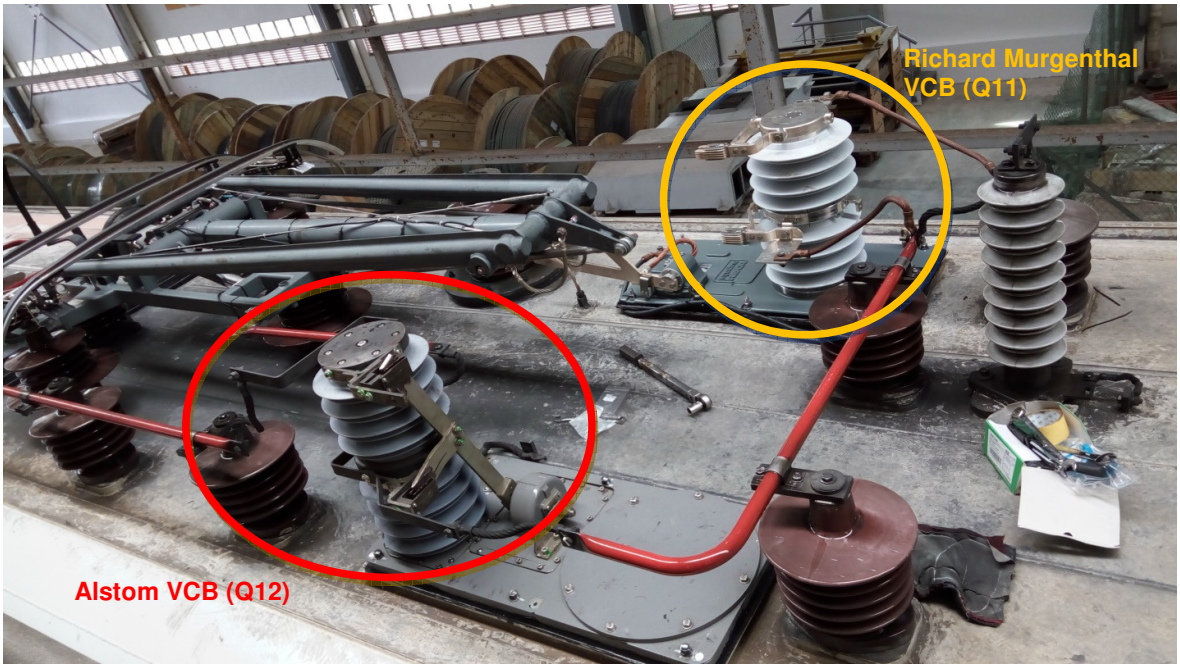

Figure 1: Both VCB in a train roof top

2 Scope, Distribution & Access

The distribution and access shall be available to all RST and PNE staff via Electronic Document Management System (EDMS).

3 Definition and abbreviation used in this procedure: -

EDMS	Electronic Document Management System
VCB	Vacuum Circuit Breaker
RST	Rolling Stock
PNE	Project & Engineering
BOM	Bill of Material

4 Operational Comparison for Alstom's and Richard Murgenthal's VCB

The following is the comparison for both types of VCB:

Description	Alstom's VCB, (Figure 2)	Richard Murgenthal's VCB, (Figure 3)
Connection type	Bayonet	Harting (adaptor is required), refer doc no. G00.OMD.M92020.YQ. 1001.*
Earthing device actuator	Pneumatic	Hand Crank (Figure 7)
Pneumatic Connection	5 (HV contact x1, earthing actuator x2, pantograph actuator x2)	1 (HV contact x1)
DDU Display when earthed	Yellow box for Pantograph	None, but pantograph actuator is restricted via electrical signal cut-off
Pantograph restriction function	Cut-off via pneumatic valve located inside VCB	Cut-off signal, as stated at 6.2 Electrical Connection via electrical contact located inside VCB
Earthing Key location	Located at side 2 roof cornice (nearby door 33/2)	Located inside individual VCB chassis
Operating Pressure	4.5 ~ 9 Bar	5 ~ 10 Bar
Respond Time	Close: 20ms Open: 10ms	Close: <60ms Open:<100ms
Similarities	Use key to activate the earth contact (knife contact)	

Table 1: Comparison between Alstom's & Richard Murgenthal's VCB.

Figure 2: Alstom's VCB

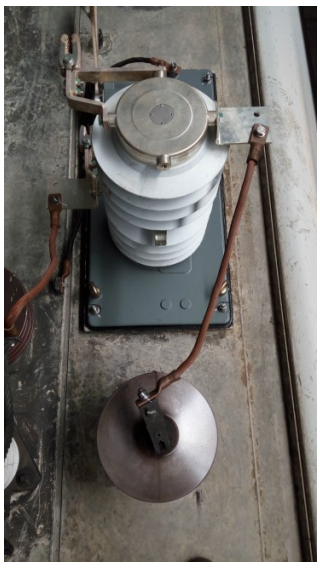

Figure 3: Richard Murgenthal's VCB

*Refer the latest version

5 Installation and Testing Method

The installation instruction can be obtained from item 4.2 doc. no.: G00.OMD.M92020. YR.1001.A.

Several tests have been conducted such as: -

1. Off – Board Testing, item 6.1
2. On – Board Testing, item 6.2
3. Insulation Resistance Testing, item 6.3 (Table 5, number 2)

6 Testing Summary

The VCB was installed to train X105 on 15 August 2017. The testing & commissioning was completed on 15 September 2017. It has been tested for off-board for auxiliary contact (refer 6.1 Off-Board Testing) and response time and actual operation (refer 6.2 On-Board Testing).

The test was executed according per the following: -

1) "Explanation System-Test VCB Off- and On-board" doc. no.: G00.OMD.M92020.CX.1002. *.
2) ANSI/NETA ATS-2009, section 7.6.3 "Circuit Breakers, Vacuum, Medium-Voltage".
3) IEEE STD 43-2013, Section 5.3 "Insulation Resistance Readings" and section 12.3 "Insulation Resistance".

Only some of the points in item 2 were executed since the unit under test in a new unit. The main objective of this test is to check the compatibility of the new VCB to our SIEMENS train.

6.1 Off-Board Testing

The actuation of the VCB was triggered using VCB Test Equipment (refer figure 4) and the resistance was measured using a multimeter. The VCB has been tested using VCB Test Equipment by referring the doc. no.: R00.OMR.M92020.DK.1001. *, Vacuum Circuit Breaker (VCB) Test Equipment.

The test equipment is connected directly to VCB Test Equipment with bayonet connector.

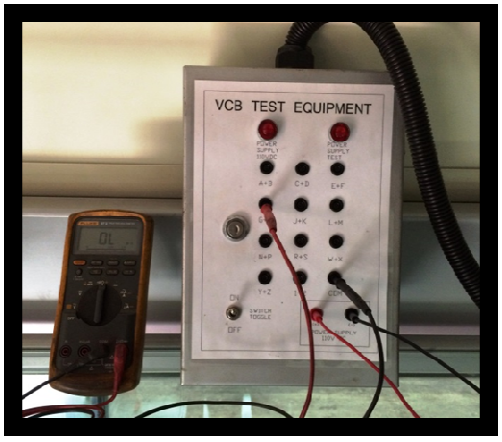

Figure 4: VCB Test Equipment

*Refer the latest version

Pin Richard Murgenthal (Harting Plug)	Pin from train connector (Bayonet Plug)	Result (Ohm)
1 +2	L + M	0.3
5+ 6	N + P	0.2
3 + 4	A + B	OL
7 + 8	C + D	OL
9 + 10	R +S	0.3
11 + 12	J + K	OL
17 + 18	E + F	OL
23 + 24	G + H	OL

Table 2: Auxiliary Contact Resistance during VCB De-Energised State

Pin Richard Murgenthal (Harting Plug)	Pin from train connector (Bayonet Plug)	Result (Ohm)
1 +2	L + M	OL
5+ 6	N + P	0.3
3 + 4	A + B	OL
7 + 8	C + D	0.3
9 + 10	R +S	OL
11 + 12	J + K	0.3
17 + 18	E + F	0.3
23 + 24	G + H	0.3

Table 3: Auxiliary Contact Resistance during VCB Energised State

OL means open loop

6.2 On-Board Testing

The actuation of the VCB was triggered using train borne control (Sibas Klip). Oscilloscope was used to measure the time-travel analysis. The analysis connection can be referring to G00.OMD.M92020.CX.1009.*.

6.3 Test Result

Visual and Mechanical Inspection are made according to ANSI/NETA ATS-2009, section 7.6.3.1. Please note that some of the test in the document is not applicable to the testing because we are testing new unit.

*Refer the latest version

Number**	Description	Result
1	Compare equipment nameplate data with drawings and specifications	Passed
2	Inspect physical and mechanical condition	Passed
3	Inspect anchorage, alignment, and grounding	Passed
4	Verify that all maintenance devices such as special tools and gauges specified by the manufacturer are available for servicing and operating the breaker	One isolating lever provided as stated in doc no. G00.OMD.M92020.CX.1003. *, Explanation key lock system old and new VCB
5	Verify the unit is clean	Passed
6	Perform all mechanical operation tests on the operating mechanism in accordance with manufacturer's published data	VCB Actuation: Passed Earthing Actuator: Passed
12	Perform time-travel analysis	Refer to G00.OMD.M92020.CX.1008. *, RM VCB: Offline - Check (Oscilloscope & VCB Tester)
13	Record as-found and as-left operation counter readings	Passed, counter increment by 1 for each operation

Table 4: The inspection description and result according to ANSI/NETA ATS-2009, section 7.6.3.1

Visual and Mechanical Inspection are made according to ANSI/NETA ATS-2009, section 7.6.3.2. Please note that some of the test in the document is not applicable to the testing because we are testing new unit.

Number**	Description	Result
1	Perform resistance measurements through bolted connections with a low-resistance ohmmeter	Passed, all high voltage electrical joints to/from VCB have less than 1Ω
2	Perform insulation resistance between live parts of external of the VCB and grounding.	Passed, refer doc. number G00.OMD.M92020.CX.1007. *
6	Verify correct operation of any auxiliary features such as electrical close and trip operation, trip-free, and anti-pump function.	Passed from Table1 & 2, refer to 5.1 Off-Board Testing.
11	Perform a dielectric withstand voltage test in accordance with manufacturer's published data.	Refer to section 2.2.2. Technical Data, Main Circuit, G00.OMD.M92020. YR.1001. *, Vacuum circuit breaker, RM 559 and RM 559-202

Table 5: The inspection description and result according to ANSI/NETA ATS-2009, section 7.6.3.2

The Richard Murgenthal's VCB contact test was done using an oscilloscope for checking the actual closing and open contact for the VCB after it is installed at the train. The oscilloscope displayed voltage waveform versus time (for close and open contact).

*Refer the latest version
** From the ANSI/NETA ATS-2009 standard, G00.OMD.M11420.CX.1001. *.

The result illustrated in figure 5 and 6, indicating that in the respond time for closing is 54.8ms and the open contact respond time is 56ms.

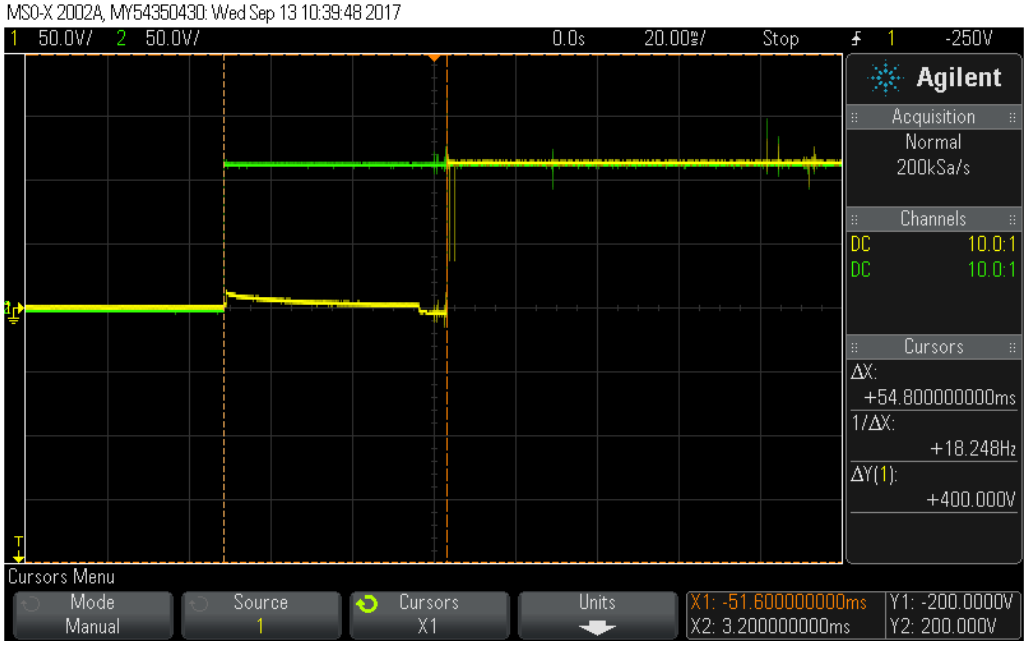

Figure 5: Respond for close contact

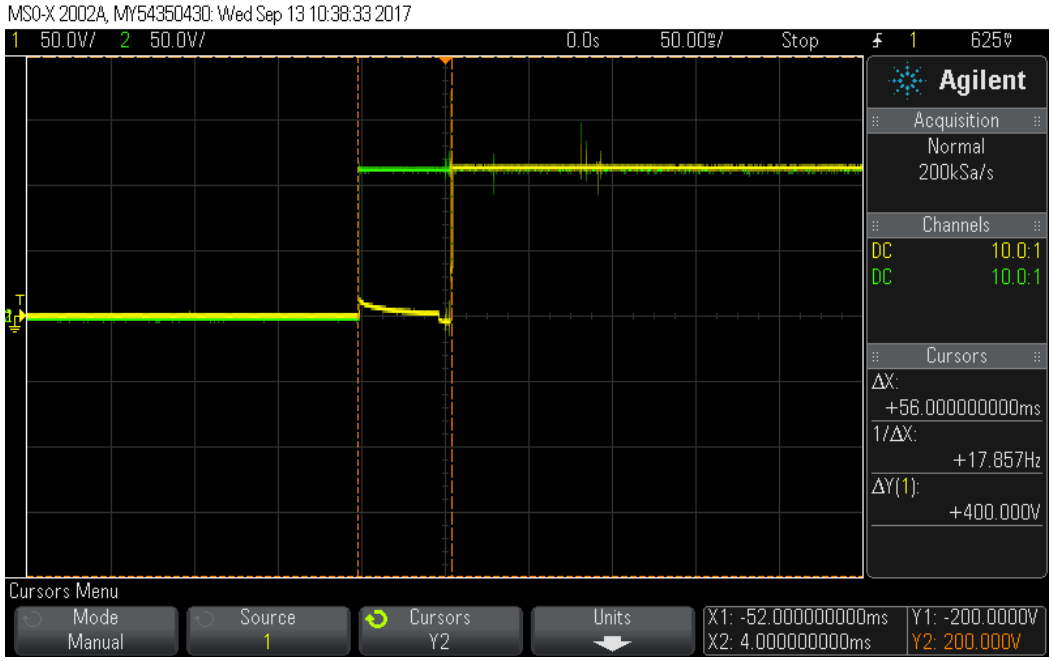

Figure 6: Respond for open contact

Dielectric strength measured from high voltage line (High Voltage Bar Bridge, Post Insulator) to the ground. The result deems to be low due to other factor from the train side. The insulation resistance using Baker IR machine result can be obtained doc no. G00.OMD.M92020.CX.1007.*.

By referring to the IEEE Std. 43, the result (table 1) recommend 5 to10kV, table 4 minimum 5Mohm for the dielectric strength insulation test.

7 Finding on the Site Test

7.1 VCB Earthing Device Operation

If a train uses two different type of VCB, the earthing devices are to be operated separately. Activating the key switch at roof cornice (nearby door 33/2), will only activate the Alstom's VCB earthing device.

To operate Richard Murgental's VCB earthing device, the operator must hand cranked the knob which located underneath the VCB, refer to G00.OMD.M92020.CX.1003. * for details. To enable this, the ceiling cover must be dismantled beforehand.

Figure 7: Hand crank

DDU will indicate yellow box for pantograph if Alstom's VCB is in earthing mode as shown in figure 6, while no obvious indication for Richard Murgental's VCB. However, CCU readout will indicate: -

"DCode: 508 Count: 3 MaintM: 0 earting disconnector of one MCU is erroneous".

*Refer the latest version

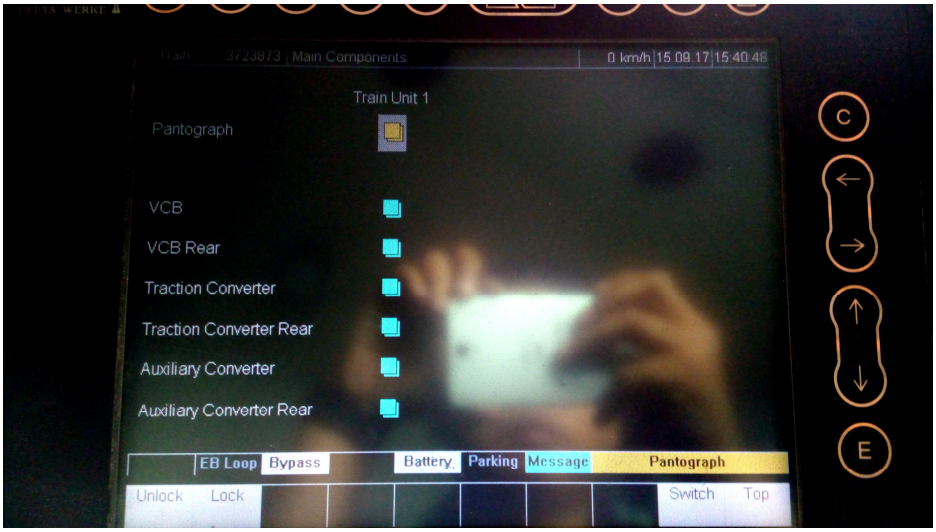

Figure 8: DDU shows yellow box on the pantograph

7.2 Closing and Opening Time Respond

Train system does not detect any anomaly. This is proven by no failure for VCB is registered in CCU readout throughout the monitoring period from 15 September 2017 to 13 October 2017.

7.3 Appearance

The Richard Murgenthal's VCB produce higher shock noise when operating compared to Alstom's VCB.

The hand crank insertion point is blocked by air duct. The air duct must be slightly pushed away to insert the hand crank device.

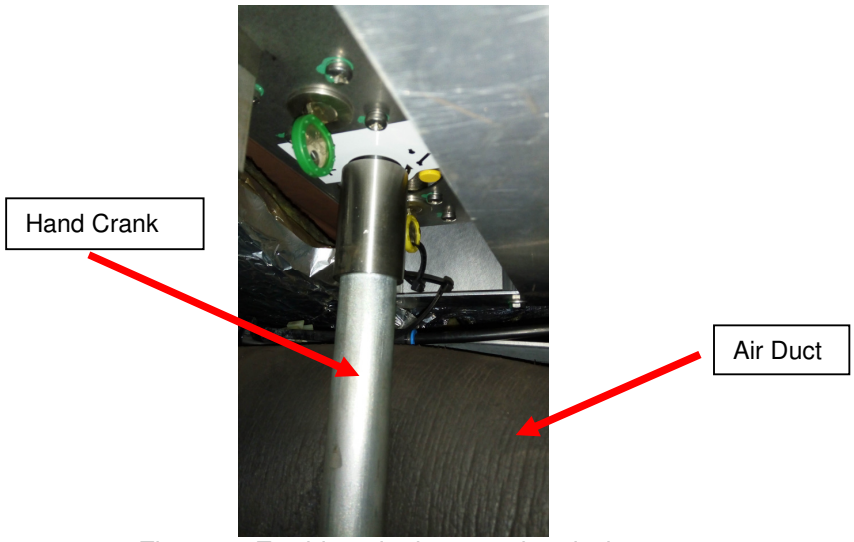

Figure 9: Earthing slot key nearby air duct

8 Modification Instruction

The following elaborate the modification instruction of installing JR 100561-202 VCB to existing SIEMENS train, for the first time.

The modification are separated into three parts as follow: -

1) Assembly Instruction
2) Electrical Connection
3) Pneumatic Connection

This modification recommendation is made to closely replicate the existing operating and safety features such: -

1) Feedback loop to all related equipment / subsystem
2) Restriction of pantograph if VCB is earthed

8.1 Assembly Instruction

It is recommended at the Richard Murgenthal's VCB is to be installed at Q11 location. This minimizes the modification required for other parts in the VCB system. If the Richard Murgenthal's VCB is installed at Q12, major modification need to be made at the post insulator. This is because the VCB's knife earthing will touched post insulator during open contact.

8.2 Electrical Connection

All auxiliary contacts are matched using the electrical adaptor.

The adaptor converts harting connection from Richard Murgenthal's VCB to train borne connector. Harting connector with wiring is provided by manufacturer. Refer to G00.OMD.M92020.CX.1005. * for bayonet connector pin installation instruction (for pin conversion).

The adaptor wiring can be referred to G00.OMD.M92020.YQ.1001. *.

Please note that wire 210123.03 (3V21/3.7) and 21123.01 (5S21/1.5) from train borne connector must be modified. Refer to diagram G00.OMD.M92020.YQ. 1001.*. The modified wiring connection must be check by using multimeter via continuity technique to ensure it in good condition.

A modification for restricting pantograph function is made where VCB's auxiliary S1 NO contact will cut-off the electrical signal to magnet valve (=28 – A12.X1). In previous Alstom's VCB assembly, a pneumatic valve located inside the VCB controls the pantograph restriction function.

*Refer the latest version

8.3 Pneumatic Connection

Only one pneumatic connection is connected to VCB. This is to actuate the HV contact. Other pneumatic connections of the VCB are bypass. Can be refer dashed circle in doc. no. G00.OMD.M92020.XH. 1001.* are bypassed using straight fitting (straight push in fittings 8 to 8 as stated in BOM fitting components). The new pneumatic connection is required to do the leak test by using soap water.

The earthing actuation is replaced by hand crank tool while the pantograph restriction function is replaced by electrical auxiliary contact in the VCB.

9 Suggestion and Recommendation

1) Visually inspect the base plate mounting and the sealant because this VCB produce higher shock when in operation.
2) No hand crank mount available, it should be placed somewhere secured inside the train fitted with this VCB.
3) OPS must be informed about the Richard Murgenthal's VCB when it is fitted to the train.

10 List of Documents for Richard Murgenthal Vacuum Circuit Breaker

Document Description	Document Number
Bill of Material	G00.OMD.M92020.CX. 1006.*
RM VCB: Adapter for VCB	G00.OMD.M92020.YQ. 1001.*
Vacuum circuit breaker, RM 559 and RM 559-202	G00.OMD.M92020. YR.1001. *
VCB Richard Murgenthal Drawing	G00.OMD.M92020.CX. 1001.*
RM VCB: Explanation key lock system old and new VCB	G00.OMD.M92020.CX. 1003.*
RM VCB: Explanation system test VCB off and onboard	G00.OMD.M92020.CX. 1002.*
RM VCB: Drawing CAD	G00.OMD.M92020.XF. 1001.*
RM VCB: Product information KABA 1008C,25 M74	G00.OMD.M92020.CX. 1004.*
ECN - RM VACUUM CIRCUIT BREAKER	G00.OMD.M11161.DF. 1001.*
RM: PNEUMATIC MAIN SWITCH LAYOUT	G00.OMD.M92020.XH. 1001.*
RM VCB: Pin Conversion	G00.OMD.M92020.CX. 1005.*
RM VCB: Offline - Check (Oscilloscope & VCB Tester)	G00.OMD.M92020.CX. 1008.*
RM VCB: Time - Travel Analysis (Train Borne)	G00.OMD.M92020.CX. 1009.*

*Refer the latest version

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Explanation key-lock-system old and new vcb

Existing key-lock-system

Number 1: Existing key of vcb/earthing switch

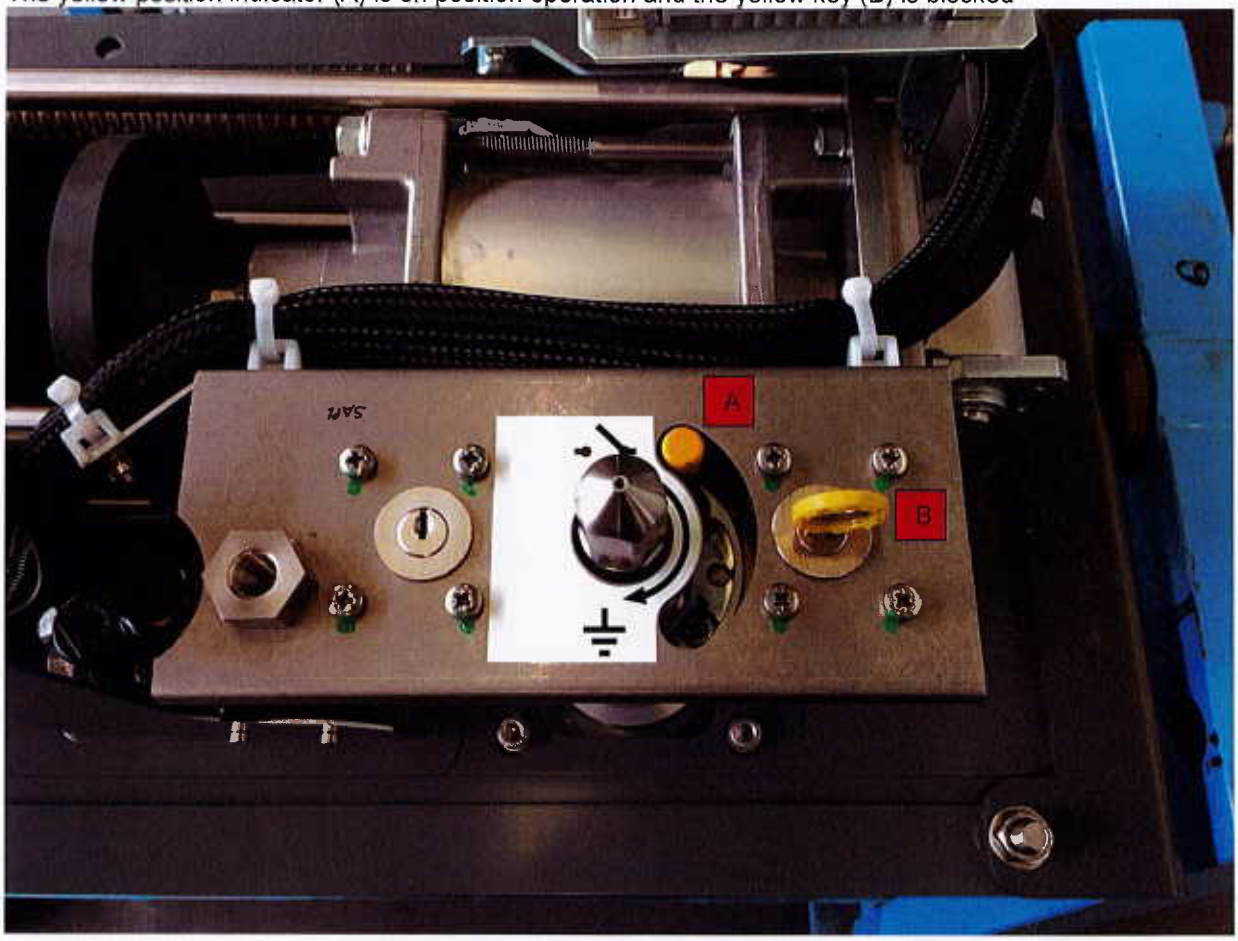
Number 2: Existing key-lock transformer

According to Amir Nordin, there's another key for the pantograph valve, which blocks the air-supply to the pantograph, when it is removed from the valve.
Please send a picture of this key and the key-lock at the panto-valve.

New key-lock-system

Vcb RM 559-202 in operation position

The yellow position indicator (A) is on position operation and the yellow key (B) is blocked

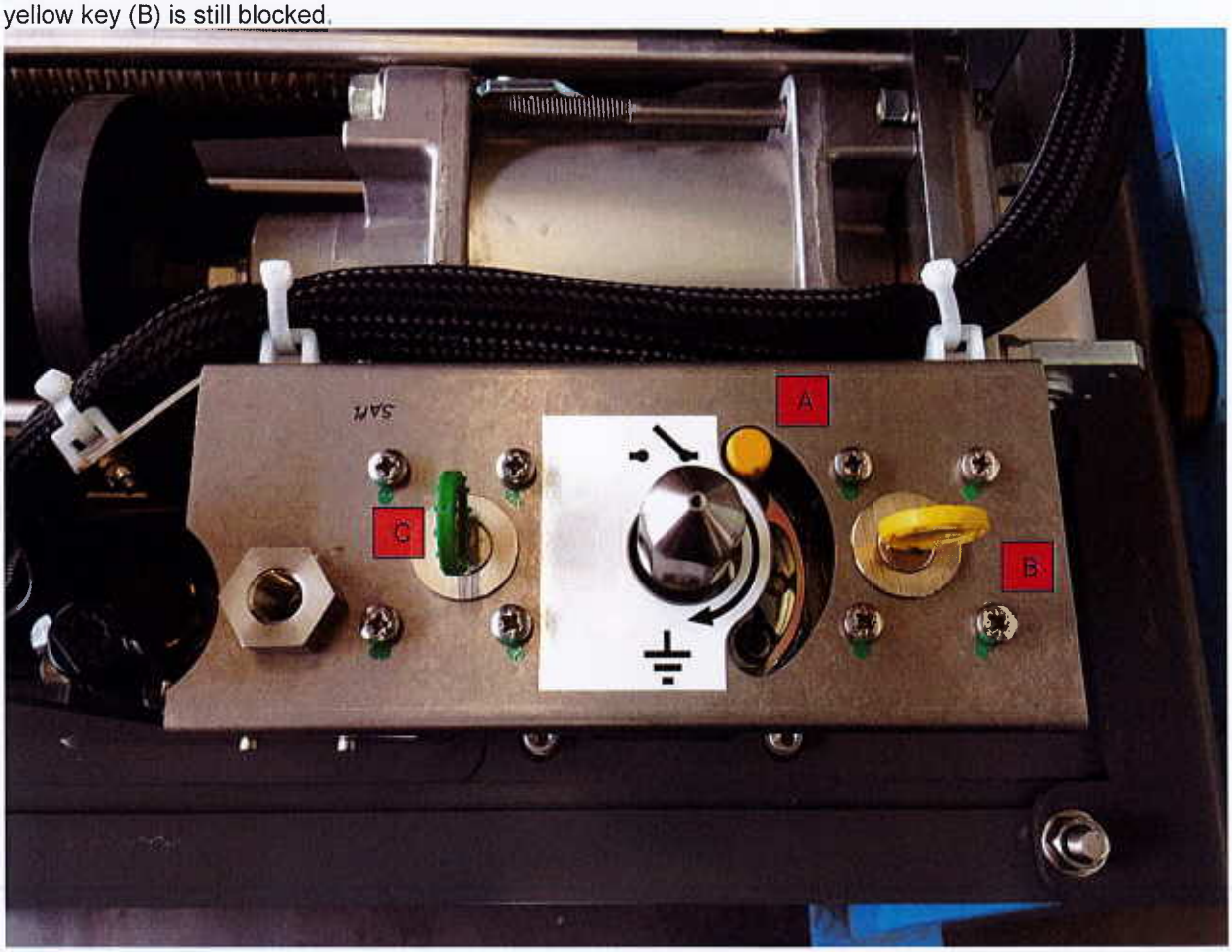


Installation of new vcb with the existing key number 2:
The key number 2 shall be connected with a key ring to the yellow key (B). This ensures the use of the existing key-lock of the transformer door.

Possible solution to use only the new yellow key (B):
Buying a key-lock from KABA similar to the existing one. This key-lock shall have the key-code BS 2856 A.

Vcb in operation position with pantograph key and earthing switch blocked

The green key (C) is from a new panto-valve-key-lock. The panto-valve with the same key-code could be provided from Richard AG with JR 502620. The yellow position indicator (A) is on position operation and the yellow key (B) is still blocked.

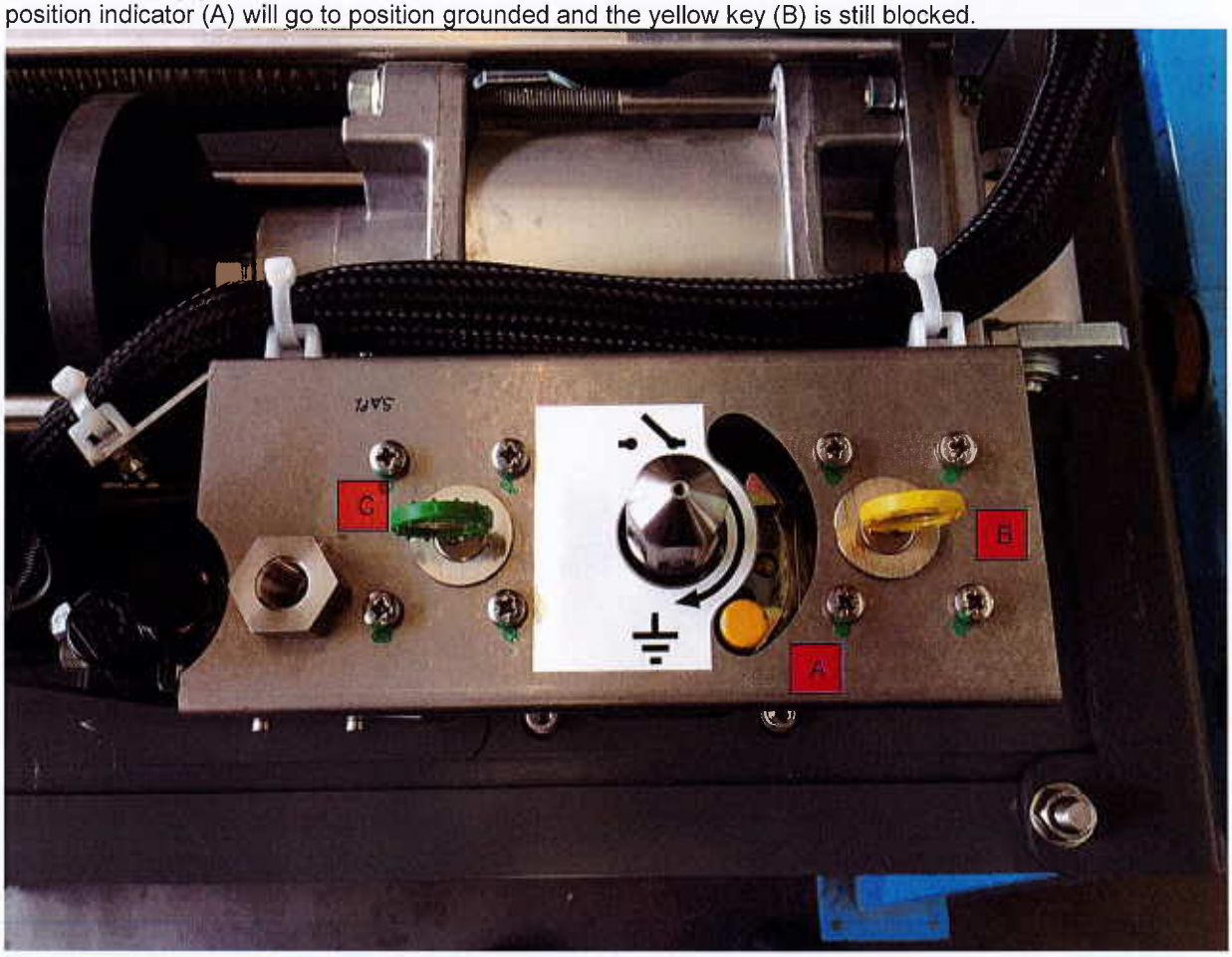


Installation of new vcb with the existing key number 1 and existing panto-valve-key:
The key number 1 isn't used anymore for the new installation. The existing panto-valve-key shall be connected with a key ring to the green key. This ensures that when the panto-valve-keys are away from the panto-valve, the pantograph couldn't be lifted, when the vcb will be earthed.

Possible solution to use only the new green key (C):
Replacing the existing panto-valve with the panto-valve JR 502620. This panto-valve shall have the key-code 374145.

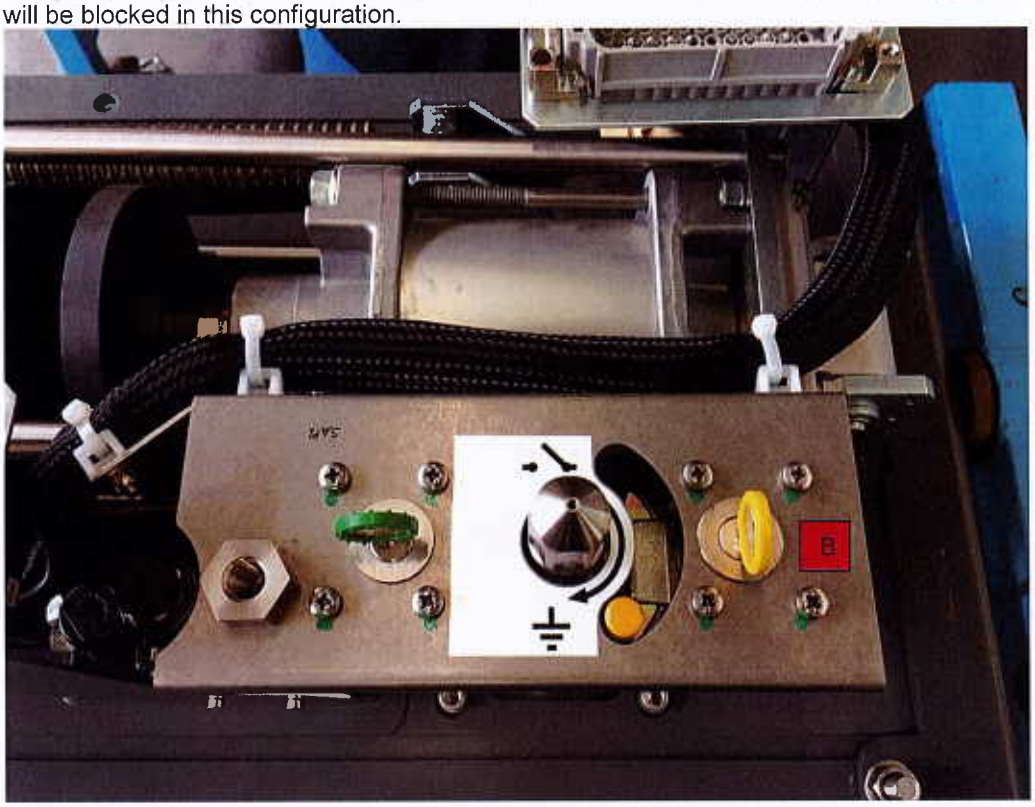
Vcb in grounded position with pantograph key and earthing switch manually activated

The green key (C) has to be turned 90°. Now the earthing switch can be actuated manually. The yellow position indicator (A) will go to position grounded and the yellow key (B) is still blocked.



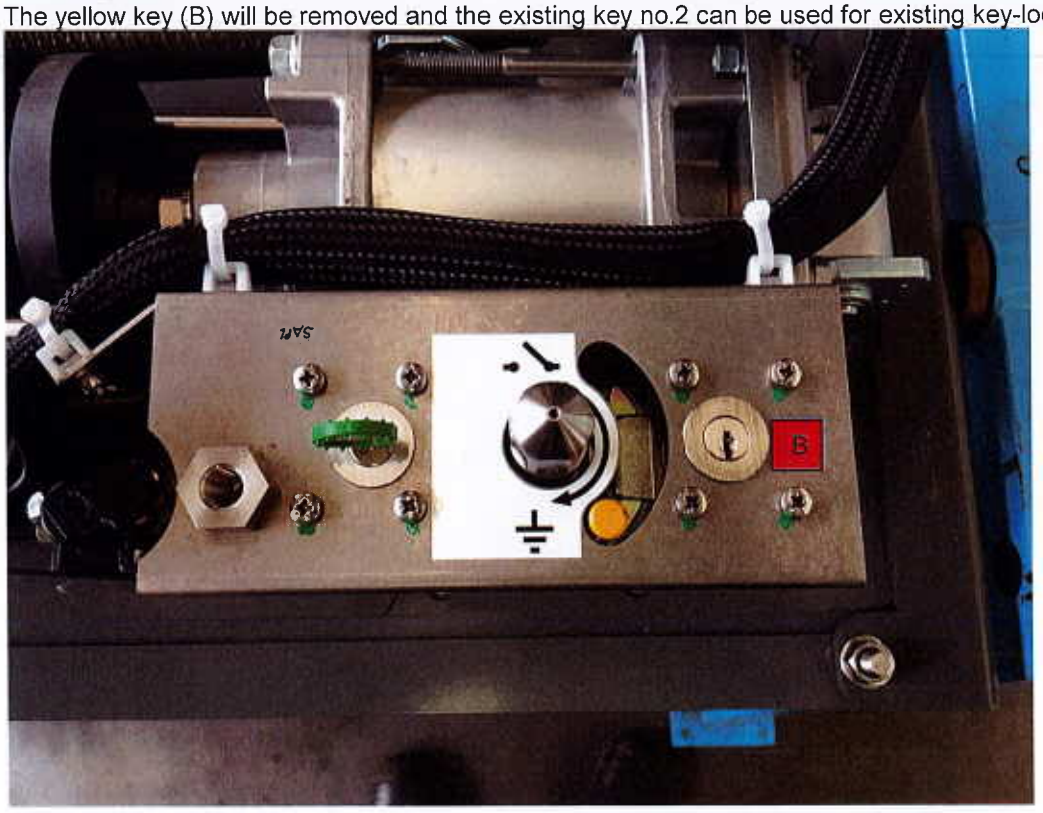
Vcb in grounded position with transformer key and earthing switch blocked

The yellow key (B) have to be turned 90° and will be released to take out of the key-lock. The earthing switch will be blocked in this configuration.



Vcb in grounded position and removed transformer key

The yellow key (B) will be removed and the existing key no.2 can be used for existing key-lock no. 2.



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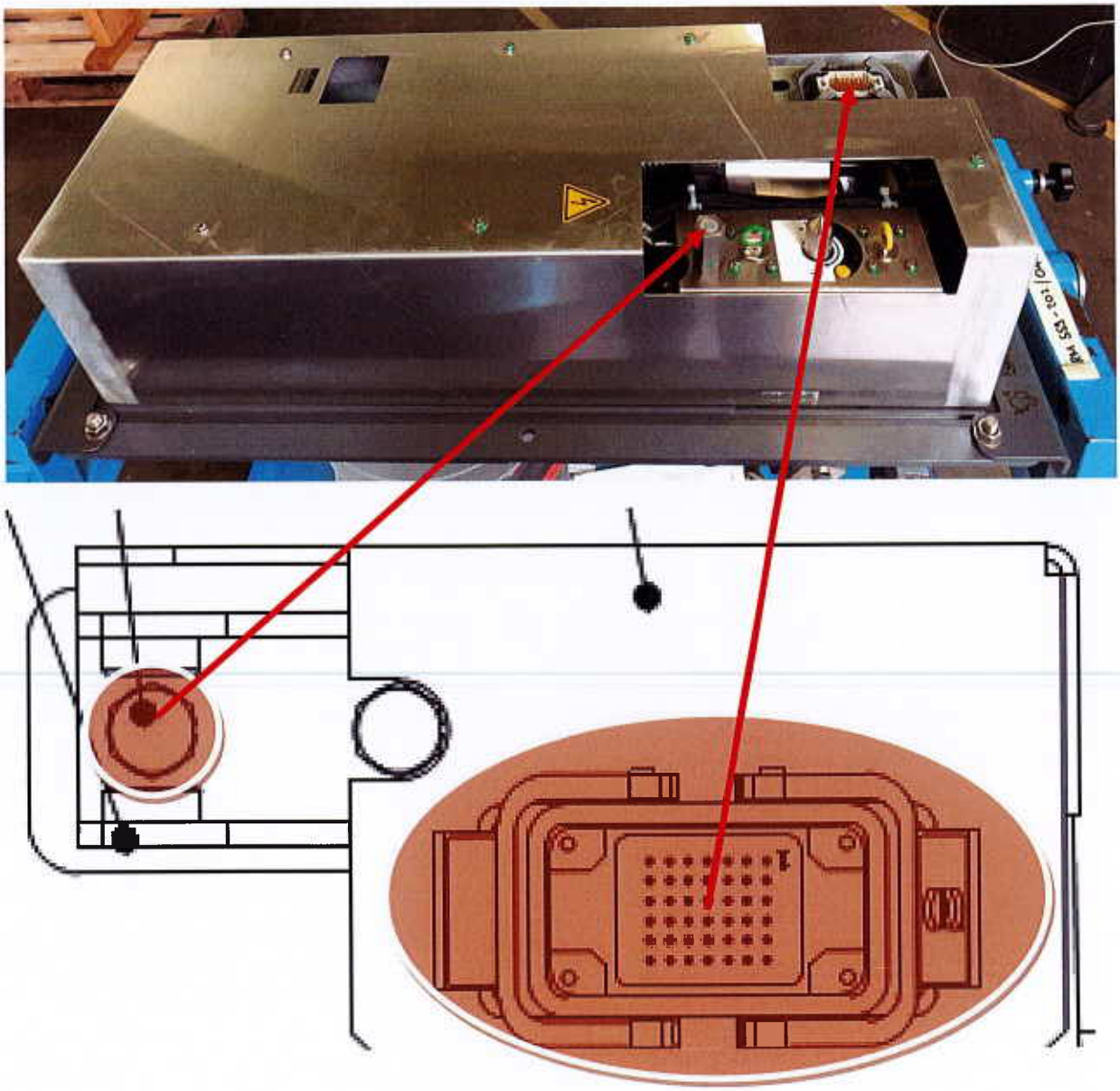
Explanation system-test vcb off- and on-board

View on top of vcb and detail plug HAN 42DD



Electrical interface over plug HAN 42DD

According to diagram JR 202386 following pins are used for this vcb:

- Pin 1 to 24 for the auxiliary signals from vcb (6NC+6NO)
- Pin 25 to 30 for auxiliary signals from earthing switch (1NC+1NO)
- Pin 32 and 33 for close and open of vcb (110V)

Pneumatical interface over air-supply G1/4"/15

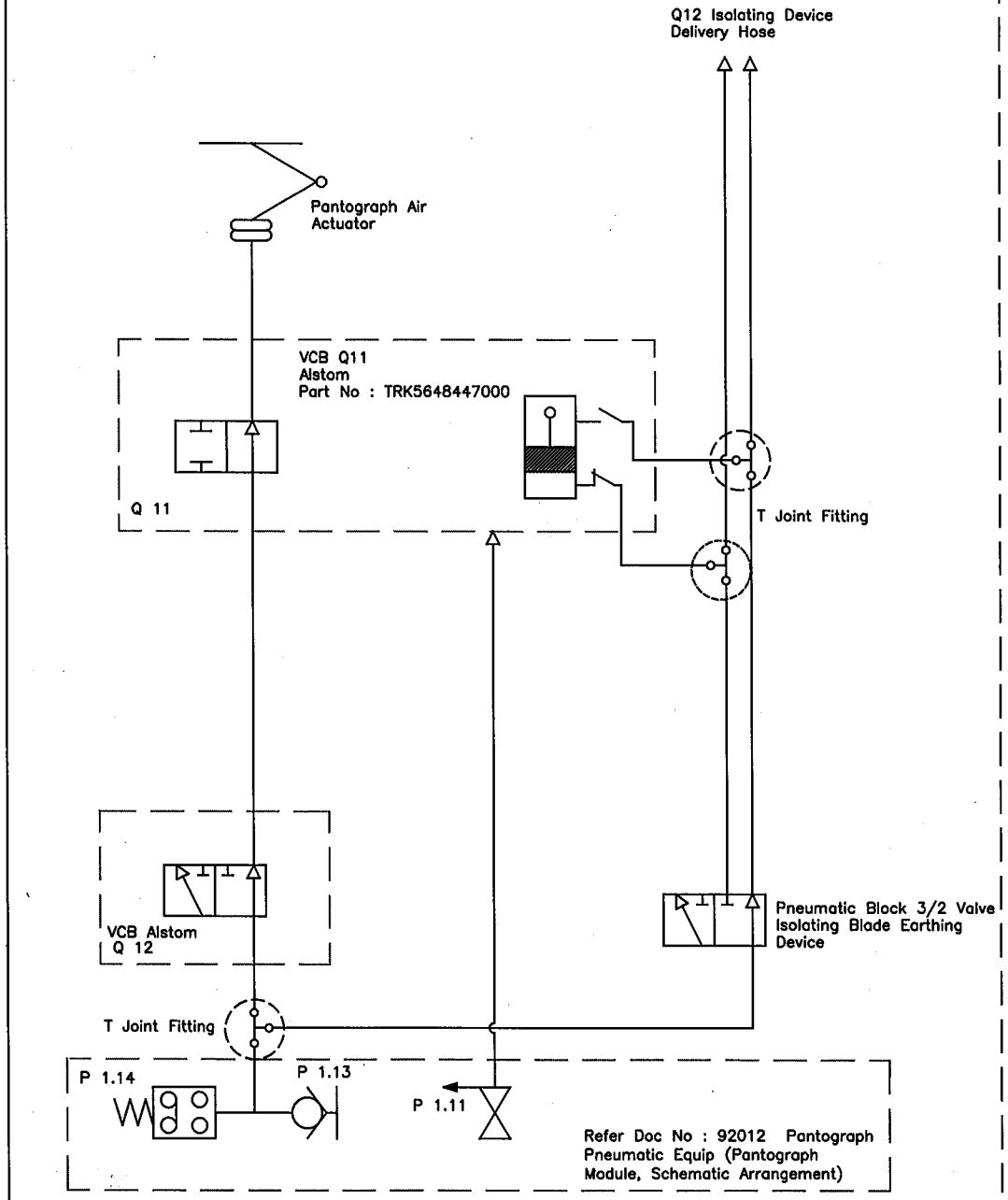
One air-supply connection over thread G1/4" with 15mm deepness

Work instruction system test vcb off- and on-board

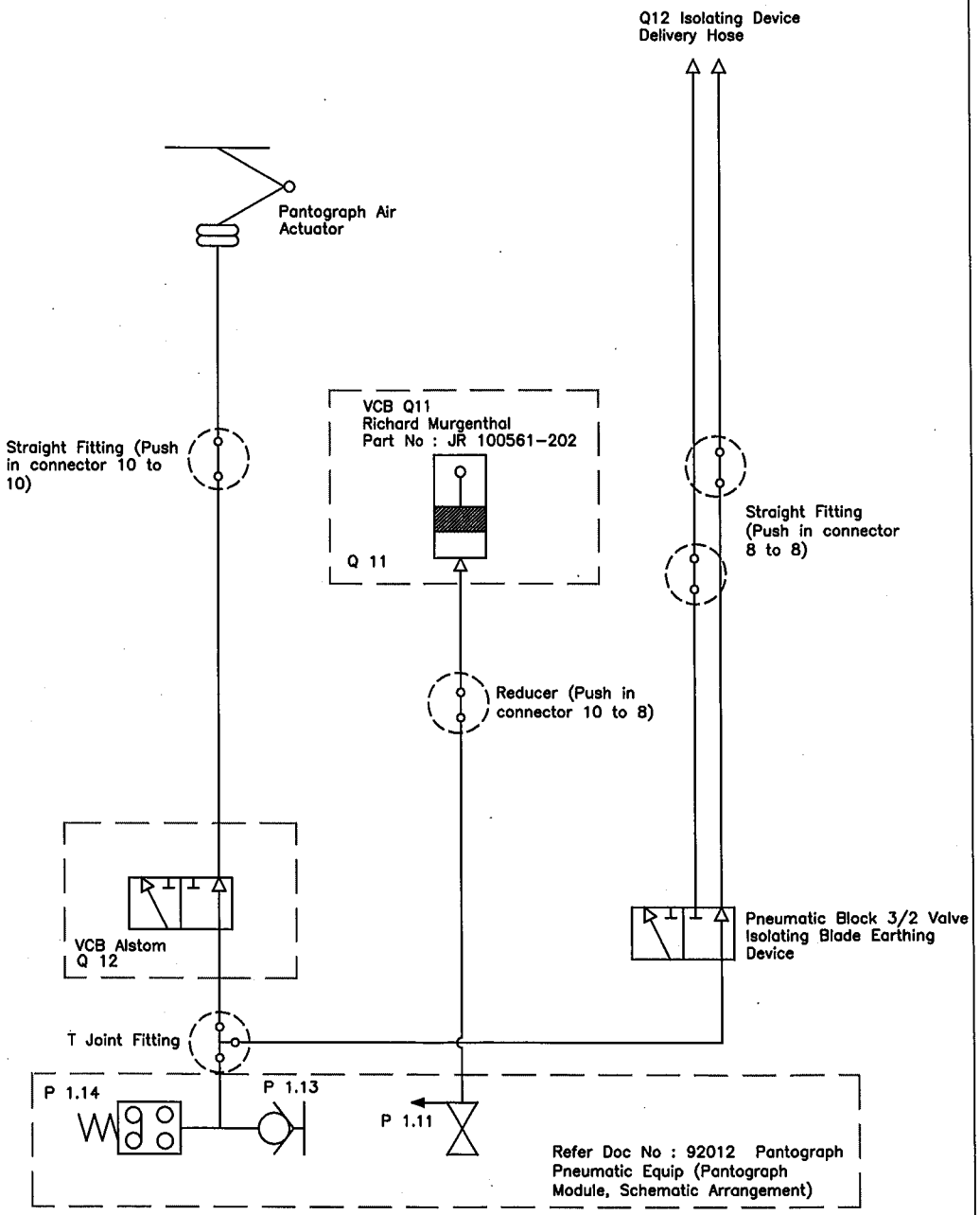
1. Putting vcb in a stable position like shown on top view picture for the off-board-test (Upside down). The area of support have to be on the ground-plate.
2. For the on-board-test removing the vehicle-plug from vcb and use the vehicle air-supply for the system-test.
3. From this point on the off- and on-board system test is identically
4. Check the auxiliary switch signals on pins 25 to 30 from earthing switch according diagram JR 202386 in both positions "grounded" and "open". This check have to be done with a continuity tester.
5. Check the auxiliary switch signals on pin 1 to 24 from open position vcb according diagram JR 202386. This check have to be done with a continuity tester.
6. Connect now a 110V-power supply (on-board system test not from vehicle plug supplied!) to pin 32 (+) and pin 33 (-) without any power on the power-supply
7. Switch on the power supply, which results in immediate closing of the vcb.
8. Check the auxiliary switch signals on pin 1 to 24 from closed position vcb according diagram JR 202386. This check have to be done with a continuity tester. Attention! The pin of the external power supply have to be insulated, that there's no touching on 110V.
9. Switch off the power supply, which results in immediate opening of the vcb.
10. For the on-board-test removing the temporary power supply and connect again the vehicle-plug from vcb. After re-connecting of the vcb to the vehicle, there has to be done a closing-/opening-operation of the vcb with the regular vehicle control.

1	2	3	4	5	6	7	8

EXISITNG MAIN SWITCH COMPRESS AIR PIPING
BOTH VCB Q11 & Q12 ALSTOM



NEW MAIN SWITCH COMPRESS AIR PIPING
VCB Q11 RICHARD MURGENTHAL & Q12 ALSTOM



Rev.	Remark	Date	Name		
				Date	24 October 2017
				Drawn	Amir Nordin
				Date	24 October 2017
				Appr.	Muhamad Dzulfaqar

PNEUMATIC MAIN SWITCH LAYOUT
ERL Maintenances Support Sdn. Bhd.
Project & Engineering Dept.

E-MAS

Rooftop
Piping Connection
Vacuum Circuit Breaker
Pneumatic Layout

G00.0MD.M92020.XH.1001.A

Release			
Date			

1	2	3	4	5	6	7	8

RICHARD MURGENTHAL VCB CONNECTION

EXISTING TRAIN VBC CONNECTION

S2 NC Contact	29	S2 – Black	250101 = 3V21/4.2	Y
	30	S2 – Blue	210116 = 3V21/3.4	Z
S1 NO Contact	25	S1 – Blue	(97–X43 Pin 34) 210123.03 Panto Solenoid = 3V21/1.6	W Series With New VCB Earthing Switch
	26	S1 – Black	(96–X20 Pin 34) 21123.01 = 5S21/1.5	X (Yellow Key)
1 (1/11)			250101 = 3V21/4.1	L
2 (2/13)			210114 = 3V21/3.3	M
3 (3/14)			230103.04 = 3V23/2.7	A
4 (4/12)			230312.02 = 3V23/2.3	B (Ack VCB ON)
5 (5/21)			230315.02 = 3V23/2.5	N (Line Contact Interlock VCB)
6 (6/22)			230316.02 = 3V23/2.6	P (Line Contact Interlock VCB)
7 (7/23)			210308 = 3V21/3.7	C
8 (8/24)			210309 = 3V21/3.8	D
9 (9/31)			230311.02 = 3V23/2.3	R (Ackn VCB Off)
10 (10/32)			230311.02 = 3V23/2.3	S (PS Contactors)
11 (11/53)			210103 = 3V21/1.7	J (VCB On Inverter 1)
12 (12/54)			210102.01 = 3V21/1.6	K (VCB Maintained)
17 (17/33)			250101 = 3V21/4.2	E
18 (18/34)			210115 = 3V21/3.3	F
23 (23/43)			250101 = 3V21/4.7	G
24 (24/44)			210115 = 3V21/3.3	H
32 (S/32:X1/2)			210204 = 3V21/2.4	U & T (Signal On & Off)
33 (S/33:X1/6)			210110 = 3V21/3.6	V

Rev.	Remark	Date	Name		
				Date	19 September 2017
				Drawn	Amir Nordin
				Date	19 September 2017
				Appr.	Dzulfaqar Yusoff

Adapter For Richard Murgenthal VCB
ERL Maintenances Support Sdn. Bhd.
Project & Engineering Dept.

E-MAS

Adapter
Functional Diagram
Roof Equipment
Wiring Diagram

G00.0MD.M92020.YQ.1001.B

Release			
Date			

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1 Sheets

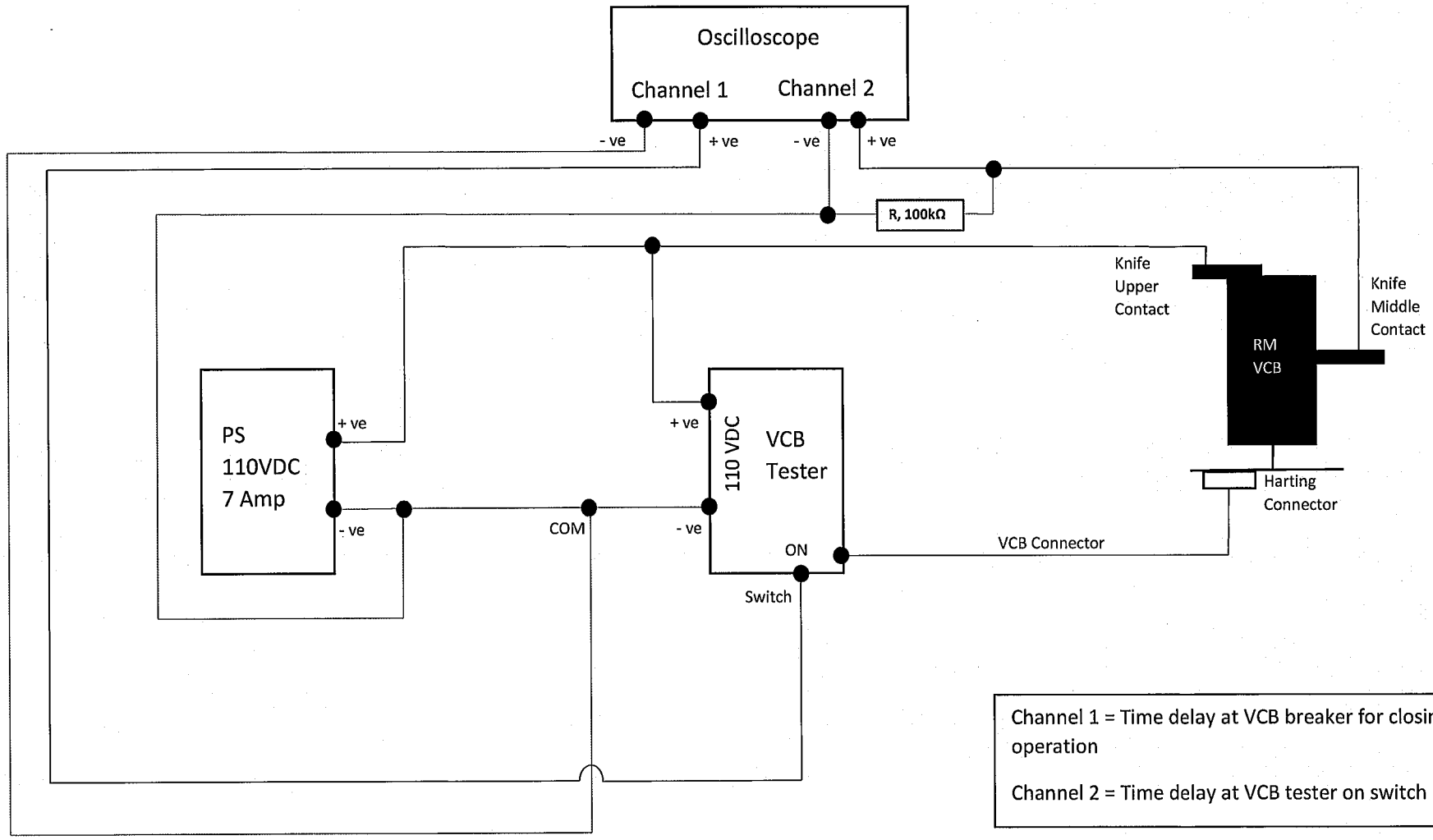
Richard Murgenthal Harting Pin to Bayonet Pin Conversion

HARTING		Connection	BAYONET
Pin Num	Cable Num		Pin Alphabet
1	1/11	< >	L
2	2/13	< >	M
3	3/14	< >	A
4	4/12	< >	B
5	5/21	< >	N
6	6/22	< >	P
7	7/23	< >	C
8	8/24	< >	D
9	9/31	< >	R
10	10/32	< >	S
11	11/53	< >	J
12	12/54	< >	K
13	13/41	< >	**N/A**
14	14/42	< >	**N/A**
15	15/63	< >	**N/A**
16	16/64	< >	**N/A**
17	17/33	< >	E
18	18/34	< >	F
19	19/51	< >	**N/A**
20	20/52	< >	**N/A**
21	21/61	< >	**N/A**
22	22/62	< >	**N/A**
23	23/43	< >	G
24	24/44	< >	H
25	S/25:S1/4	< >	**N/A**
26	S/26:S1/2	< >	Y
27	S/27:S1/2	< >	Z
28	S/28:S2/4	< >	GROUND
29	S/29:S2/1	< >	GROUND
30	S/30:S2/2	< >	**N/A**
31	**N/A**	< >	**N/A**
32	S/32:X1/2	< >	U&T
33	S/33:X1/6	< >	V

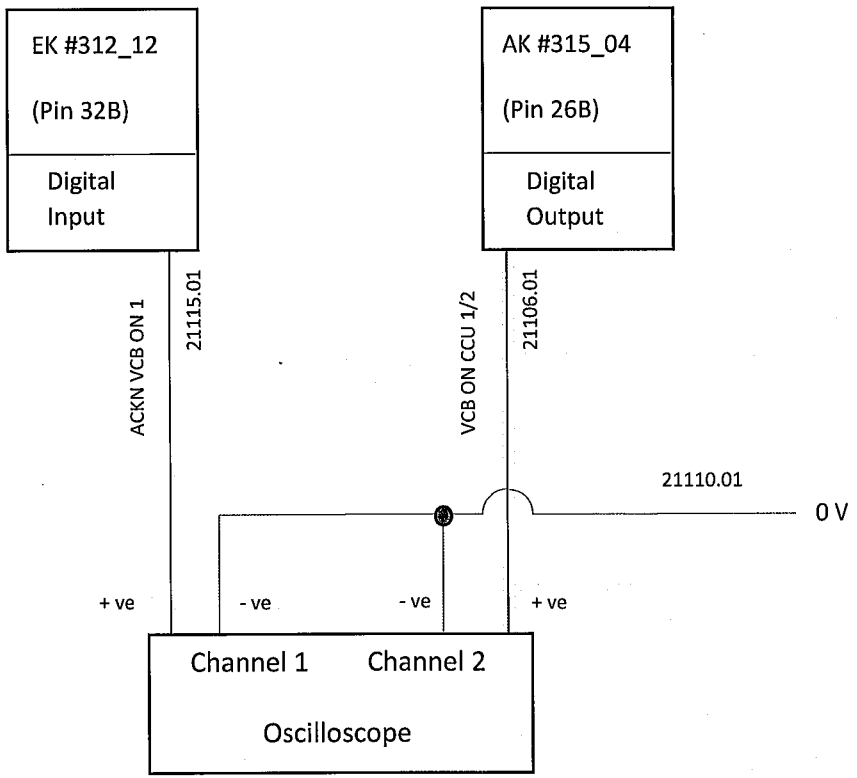
Doc No : G00.OMD.M92020.CX.1005.A

*N/A - no used

Richard Murgenthal VCB Wiring Connection from Closing and Opening Circuit Test.



On Board Testing Time - Travel Analysis (Train Borne)



RM VCB Bill Of Material , DOC NO : G00.OMD.M92020.CX.1006.A

No	Components	Description / Package	Designation / Location	Value / Component Part Number	Quantity	Supplier / Manufacturer	Part Number
1	Bayonet Pin	AB Connectors size 16 13A Male Crimp Circular Connector Contact	Bayonet Connector	24-A25 (ABB16KPKF80P3)	180	RS MALAYSIA	343-2056
2	Bayonet Female Connector	ABCIR Series, 25 Way Panel Mount MIL Spec Circular Connector Receptacle, Pin Contacts,Shell Size 24, Bayonet Coupling	Bayonet Connector	24-A25	5	RS MALAYSIA	341-8791
3	Bayonet Gasket	Connector Gasket	Bayonet Connector	24-A25	5	RS MALAYSIA	343-1788
4	Conduit Backshell Adaptor	Conduit Adaptor, For Use With ABCIRCH	Bayonet Connector	24-A25	5	RS MALAYSIA	343-1744
5	Braided Cable	RS Pro Braided Cable Sleeve 20mm Expandable PET 5m	Bayonet Connector		1 Bag (5meter)	RS MALAYSIA	408-215
6	Radox White	LF Cables	Bayonet Connector	RADOX GKW-LW 600V M	2 set (200 Meter)	Huber + Suhner	
7	VCB	Richard Murgenthal VCB	Panto VCB		4	Richard Murgenthal	
8	VCB Connector	VCB Female Connector	Panto VCB		5	Richard Murgenthal	
9	Fitting	Straight Push in fittings 10 to 10	Pneumatic Hose		20	Festo	QS-153034
10	Fitting	Straight Push in fittings 8 to 8	Pneumatic Hose		20	Festo	QS-153033
11	Reducer	Push in connector 10 to 8	Pneumatic Hose		20	Festo	QS-153039
12	Blanking Plug	Blanking plug for VCB Isolator 8	Pneumatic Hose		20	Festo	QSC-153269H
13	Fitting	Tube fitting (Push In tube 8mm – Thread male connector G1/2")	Pneumatic Hose		10	Pneuflex	PC 08 – G04