

**MANUAL FOR MULTI RESETTING TYPE VIGILANCE CONTROL DEVICE (VCD)
FOR DIESEL LOCOMOTIVES**

Model : LAX-VCD-D

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1. INTRODUCTION

LAX-VCD-D is micro controller based equipment designed and manufactured to enhance the safety of the locomotive operation by ensuring the alertness of the crew all the time. The system is multi-resetting type and operates in a fail-safe manner. The system is reset by specified normal operational activities of the crew and also by pressing an acknowledgement push button. Absence of the normal driving functions and the acknowledgement at specified intervals will activate VCD to flash a warning light and audio alarm. If still not acknowledged, the VCD will initiate the application of Penalty brake through a separate Magnet valve. The system has also provision for logging nearly 10,000 occurrences of events such as Application of penalty brake, release of penalty brake, VCD bypass, configuration changes, VCD Power ON/OFF etc with date and time stamp in its non-volatile memory. The above events can be downloaded to a PC using Analysis software. The System also has a provision to display No. Of occurrences of Penalty Brake application which increments whenever the penalty brake is applied.

The system is powered from the DC voltage available in the locomotive. It is suitable for voltage variations between 50V - 140 V DC and is thus fit for application on all Indian Railway Diesel/ Electrical Locomotives.

The Vigilance control device, Model LAX-VCD-D consists of the following units:

A. LOCOMOTIVE Mounted Equipments:

S.No.	Description	Model No.	Quantity
1.	Multi Resetting VCD Control Unit	LAX-VCD-D	01
2.	VCD Indicator cum Reset Panel	LAX-VCD-D	02
3.	Pressure Switch for SA9 Application	RT1116 of DANFOSS	01
4.	Electro Magnet Valve for Penalty Brake Application	20106-10-4G-72V-DC-28 of ROTEX	01
5.	Set of Cables	--	01

B. Shed Equipments:

S.No.	Description	Model No.	Quantity
1.	Software CD	LAX-VCD-D	01
2.	RS 232 Cable for Downloading	--	01

2. HARDWARE DESCRIPTION

2.1 Micro Controller Based VCD Control Unit

VCD Control Unit consists of

- 2.1.1 Power Supply module
- 2.1.2 Micro controller based Main Control Card
- 2.1.3 Enclosure (Shell Assembly)

2.1.1 Power Supply Module:

It is a versatile unit suitable for converting 50 to 90 V DC from Diesel locomotives battery to +5V required for Electronic circuitry. Switching mode techniques are used to allow wide variations of input voltages with high efficiency. Surge suppression, reverse voltage protection, over/under voltage protection, EMI/EMC suppression circuits, and short circuit protections are in-built. 2KV isolation is provided between the input and output circuitry.

2.1.2 Micro controller based Main control card

This assembly contains the following sub-assemblies, which perform various functions.

(a) Micro Controller:

A High-speed 8-bit Micro controller with internal program memory of 128K and data memory of 8K bytes is used. The Microcontroller has serial ports for interfacing with PC and RS485 for external world. The timings are generated through a Quartz crystal oscillator operating at 22.1184 MHz.

(b) Real Time clock:

A non-volatile Real time clock is being used in the system for recording data and time of the event. The date and time can be programmed through PC. The life of the battery is 10 years.

(c) Optically isolated Digital Input Section:

This section converts all the loco inputs like Notch, Sander, Horn, SA9 application, A9 Application, Dynamic brake, Control stand status, Vigilance push button etc. to low voltage signals. All the Inputs are optically isolated (6 KV isolation), reverse polarity protected and short circuit protected.

(d) Optically isolated Digital Output Section:

This section converts low voltage digital signals to loco outputs like Penalty Brake Output, DMR Output, Warning Light, Buzzer, Driver Indications etc. All the outputs are optically isolated (6KV isolation) from the inputs.

(e) Internal Memory:

Stores the following events with date and time stamp in internal non-volatile EEPROM memory

- (i) Penalty brake application
- (ii) Penalty brake release
- (iii) Configuration changes
- (iv) Equipment failures
- (v) Activation of Bypass switch
- (vi) De-Activation of Bypass switch.
- (vii) VCD Power ON
- (viii) VCD Power OFF

Stores about last 10,000 records of above referred events with date and time stamp in a non-volatile EEPROM memory.

(f) RS232 Port:

An RS-232 port is provided for interface with the PC/Laptop for downloading the events as well as testing the VCD. The RS232 port is configured for a baud rate of 9600.

(g) RS485 Port:

An RS485 port is provided for future communication to other microprocessor-based systems fitted in the locomotive. The RS485 port follows SAEJ-1708 protocol. It can also be used to take speed data from Speed recorder of Laxven Systems if required.

(h) Penalty brake counter:

A 5 digit seven segment LED display is provided on the control unit to display the number of penalty brake applications. This counter will get incremented whenever penalty brake is applied through VCD. This will help the crew to identify No. of penalty brake applications in a particular trip.

2.1.3 Enclosure/Shell Assembly:

A robust Steel powder coated enclosure for the Vigilance Control Device control unit is provided, to resist the ingress of dust and moisture into the instrument.

A Bypass Switch is provided on the VCD control unit. By operating this switch, the functioning of the VCD is bypassed. The Bypass switch is accessible to the user only on breaking a glass.

2.2 VCD Indicator cum Reset Panel

A robust Steel powder coated enclosure for VCD Indicator cum Reset panel is provided. One such unit is provided on each control stand/CAB of the locomotive. The VCD Indicator cum Reset panel shall be located in the control stand such that it is easily accessible to the driver without leaving his seat.

It contains the following components:

- (1) Warning Light/Alert Light: A 22.5 mm Yellow Light operating on 72V DC is used for warning light.
- (2) Proving Light: A 5 mm Blue LED is used for Proving light.
- (3) VCD Bypass indicator: A 5 mm Yellow LED is used for VCD Bypass indicator.
- (4) MU Trail mode indicator: A 5 mm Green LED is used for MU Trail mode indicator.
- (5) Penalty /Equipment Failure Indicator: A 5 mm RED LED is used for Penalty Brake indication / Equipment fail indication.
- (6) Reset Push Button: A large, rugged, solid 30.5 mm Push Button is provided for resetting the vigilance cycle by the driver.
- (7) Audio alarm / Buzzer : A 72V DC operated buzzer with 100 dBm sound is provided for audio alarm during T2 & T3 cycles.

2.3 Cables

All the cables are of 1.5 sq mm PTFE insulated, FRLS jacketed and shielded cables. The cables are terminated with M5 lugs or circular connectors. All the cables have an insulation grade of 5KV.

2.4 Pressure Switch

A Pressure switch is provided in the system for sensing the Brake Cylinder Pressure. If BCP is greater than 2.3 Kg/cm² then the Pressure switch will be ON. If BCP is less than 2.0 Kg/ cm² then the Pressure switch output will be OFF. Danfoss Pressure switch Model No. RT1116 is used for BCP sensing. The tapping of BCP pressure is taken from the delivery pipe line of the brake cylinder charging C2W relay valve.

2.5 Electro Magnet Valve

An Electro magnet valve is used to drop Brake pipe pressure in case of Penalty Brake application. The magnet valve is to be provided in the path line between A9 to MU2B valve in order to drop control pressure up to control port of additional C2 relay valve, which in turn drops Brake pipe pressure.

3. FUNCTIONAL DESCRIPTION

The system LAX-VCD-D is a microprocessor based multi-resettable and fail safe system. The system is designed to work on normally de-energized principle.

The system is based on a number of time cycles such as Vigilance cycle (T0), Warning cycle (T1), Warning Cycle (T2), Penalty brake cycle (T3), Penalty brake cycle (T4).

Operation Cycle	Time period in seconds	Indications	Remarks
Vigilance cycle (T0)	60	None	VCD can be reset
Warning cycle (T1)	17	Yellow flashing light	VCD can be reset
Warning cycle (T2)	17	Yellow flashing light & alarm	VCD can be reset
Penalty brake cycle (T3)	34	Yellow flashing light but alarm stops	VCD cannot be reset
Penalty brake cycle (T4)	Until reset	None	VCD can be reset by Push Button

Vigilance cycle time(T0):

The cycle has a preset period set at 60 seconds. This cycle is automatically restarted when the driver performs some positive action such as notching, sanding, application of brakes, horn, operation of vigilance push button etc. In normal conditions, if the driver is periodically performing some positive action, the cycle will continually reset and will never run to completion. If the driver fails to perform such an action within the cycle period, the cycle period will be completed. At that instant, the second time cycle (Warning cycle) will be initiated. If the Vigilance push button switch remains in press/ release position more than 60 sec, the system enters into the warning cycle T1.

The system is reset by operation of the frequently operated control function by the driver such as

1. Notch-up/ Notch down by the master controller
2. Operation of the sander
3. Operation of horns
4. Operation of train brake (A9)
5. Operation of loco brake (SA9)
6. Operations of Dynamic brake handle position.
7. Operation of Vigilance reset push button switch.

Warning cycle (T1):

The cycle has a preset period of 17 seconds. During this cycle a Yellow flashing LED warns the driver to acknowledge the VCD reset push button. If the driver acknowledges during this cycle, the cycle is terminated and Vigilance cycle is restarted. If the driver fails to acknowledge, VCD goes to next warning cycle.

Warning cycle (T2):

The cycle has a preset period of 17 seconds. During this cycle a Yellow flashing LED and audio alarm warns the driver to acknowledge the VCD push button. If the driver acknowledges during

this cycle, the cycle is terminated and Vigilance cycle is restarted. If the driver fails to acknowledge, VCD goes to application of penalty brake.

Penalty Brake cycle (T3): (Application of penalty brake)

The cycle has a preset period of 34 seconds. A Penalty brake indication (RED LED blinking) is also provided during this cycle. During this cycle an output signal is generated to DMR, which will bring the locomotive to idle position. During this cycle, the driver cannot reset the VCD. After the completion of this cycle, the system enters into next penalty brake cycle (T4). The penalty brake counter is incremented by one during this cycle. Data will be logged with date and time stamp at the start of T3 time (Application of Penalty brake).

Penalty Brake cycle (T4): (Release of penalty brake)

This cycle is a continuous cycle and will be reset only when the following conditions are fulfilled

- (a) Throttle handle has been brought to IDLE
- (b) Vehicle speed is zero / BCP is ≥ 2.3 Kg/cm²
- (c) RESET button is pressed.

When the above conditions are met, the penalty brake is released and visual warning is cancelled and normal vehicle operation can be re-established. Data will be logged with date and time stamp at the end of T4 time. (Penalty brake release)

MU Operation:

The VCD system will be disabled on a slave locomotive in multiple operations. The vigilance will be automatically suppressed when both the control stands are set to OFF Position. (MCB1 and MCB2). A MU Trail mode indicator (Green) will glow when the loco is in the slave mode.

Vigilance suppression:

The operation of the VCD is suppressed when continuous proof of driver's vigilance is not required. The suppression of VCD works only in T0 cycle and not in other cycles. The suppression of the vigilance system shall be done in the following conditions

- (1) BCP is ≥ 2.3 Kg/cm²
- (2) Vehicle speed is less than 3 km/h

Vigilance Bypass/isolation:

A Bypass Switch is provided on the VCD unit. By operating this switch, the functioning of the VCD is bypassed. A breakable glass is provided on the switch. In order to bypass the VCD, the glass has to be broken and the switch should be put to ON condition. Once the switch is ON VCD will not function and the penalty brake is released. Data is logged with date and time stamp whenever this switch is made 'ON' (VCD bypassed) and again made OFF (VCD reactivated after bypass). A Bypass LED (Yellow) is provided to indicate that VCD is in bypass condition.

Data logging and PC interaction:

The following events are logged in the non-volatile EEPROM memory of the control unit with date and time stamp.

- (1) VCD Power ON
- (2) VCD Power OFF
- (3) Application of Penalty brake

- (4) Release of Penalty brake
- (5) VCD bypass
- (6) VCD reactivation after bypass
- (7) Configuration changes
- (8) Equipment failures

The above events for last 10,000 events are stored in sequence and can be downloaded to a PC/LAPTOP through RS232 port using downloading and analysis software.

Interfacing with other Microprocessor based systems

LAX-VCD-D can interact with other microprocessor-based systems fitted in the locomotive through RS485 communication with a predefined protocol.

The protocol can be standardized as per the requirements.

Fail safe feature

LAX-VCD-D is designed to work in fail-safe mode. i.e, penalty brake will initiate and DMR output will be de-activated to bring the locomotive to IDLE condition for any fault in the vigilance control system. The VCD system will work in fail safe mode (initiate penalty brake and de-activate the DMR output) in the following conditions:

- 1. Power cable to the VCD Control unit is removed**
- 2. Power supply card failure**
- 3. Main control card failure**

In case there is a problem in the VCD equipment itself, the driver has to break the Bypass Switch glass and put the Bypass switch to 'ON' position for normal operation of the locomotive.

VCD INPUT/OUTPUT LOGIC (VCD-D)

TO = 60 ± 2 SECONDS
T3 = 34 SECONDS

T1 = 17 ± 2 SECONDS
T4: UNTIL RESET

T2 = 17 ± 2 SECONDS

VCD INPUT ACKNOWLEDGEMENT

SI No	Input	T0	T1	T2	T3	T4	Fault Cycle	Remarks
1	Bypass Switch	◆	◆	◆	◆	◆	◆	Continuous Suppression
2	Control Stand (1/2)	◆	◆	◆	*	*	*	Continuous Suppression in T0, T1 and T2
3	SA9 (Loco Brake)	◆	*	*	*	*	*	Continuous Suppression in T0
4	Driver Acknowledgement Push Button Switch	#	#	#	*	#	#	Momentary Reset & Removing Penalty Brake
5	A9 (Train Brake)	#	#	#	*	*	*	Momentary Reset
6	Horn-1	#	#	#	*	*	*	Momentary Reset
7	Horn-2	#	#	#	*	*	*	Momentary Reset
8	Sander-1	#	#	#	*	*	*	Momentary Reset
9	Sander-2	#	#	#	*	*	*	Momentary Reset
10	Notch-0 / IDLE	--	--	--	--	#	#	Removing Penalty Brake
11	Notch 0 – 1	#	#	#	*	*	*	Momentary Reset
12	Notch 1 – 2	#	#	#	*	*	*	Momentary Reset
13	Notch 2 – 3	#	#	#	*	*	*	Momentary Reset
14	Notch 3 – 4	#	#	#	*	*	*	Momentary Reset
15	Notch 4 – 5	#	#	#	*	*	*	Momentary Reset
16	Notch 5 – 6	#	#	#	*	*	*	Momentary Reset
17	Notch 6 – 7	#	#	#	*	*	*	Momentary Reset
18	Notch 7 – 8	#	#	#	*	*	*	Momentary Reset
19	BKCP 1 – 2	#	#	#	*	*	*	Momentary Reset
20	BKCP 2 – 3	#	#	#	*	*	*	Momentary Reset
21	BKCP 3 – 4	#	#	#	*	*	*	Momentary Reset
22	BKCP 4 – 5	#	#	#	*	*	*	Momentary Reset

* → Cannot Reset VCD

→ Can Reset VCD

◆ → Continuous Suppression

-- → Not Applicable

VCD OUTPUT STATUS

SL No	Input	VCD Bypass	MU MODE	T0	T1	T2	T3	T4	Fault Cycle
1	VCD Active LED (Blue)	*	#	#	#	#	#	#	*
2	Warning LED (YELLOW)	*	*	*	@	@	@	*	*
3	Bypass LED (YELLOW)	#	*	*	*	*	*	*	*
4	MU LED (GREEN)	*	#	*	*	*	*	*	*
5	Brake/VCD Fail LED (RED)	*	*	*	*	*	@	#	#
6	Audible Alarm (Buzzer)	*	*	*	*	#	*	*	*
7	Penalty Brake Output	*	*	*	*	*	#	#	#
8	DMR Output	*	*	*	*	*	#	#	#

* → OFF

→ ON

@ → BLINKING

-- → Not Applicable

4. INSTALLATION & COMMISSIONING

LAX VCD –D is a Microprocessor based Electronic instrument of precision class and should be handled as such. The system, once properly installed, will withstand the loco environment without any problem and will give completely satisfactory service. However, extreme care is required from properly trained personnel for the installation and commissioning for the first time. Unauthorized or untrained persons should not be allowed to open or handle the system.

The LAX-VCD-D system is supplied in good quality packing boxes, along with packing list as per order and should be verified. If any components are missed, should be reported with in a week from the supply of the materials. Before opening of the boxes, they should be checked for any gross mishandling and/or damages during transportation. In case the contents are not damaged during transportation, the system can be mounted on the locomotive and will function as designed.

4.1 In case of any doubts about damages during transportation, the following quick checks can be done before installation of the system on the locomotive.

* For cables, perform continuity check with a continuity meter.

* For VCD Control unit, energize with correct voltage and check the system is powered ON. Also check for the display.

* For VCD Indicator cum Reset panel units, connect to VCD control unit (with cable-1 and cable-2) and check for LED glowing.

4.2 INSTALLATION OF VARIOUS UNITS.

4.2.1 Installation of VCD Control unit.

Information : Refer Inter connection diagram in the annexure
Installation Procedure: VCD control unit has to be placed in drivers cab at suitable place which shall not hinder the driver operations. The Placement of the control unit should be such that the bypass switch should be easily accessible when required. The respective cables are to be drawn from respective connectors and terminate them at Loco TB, VCD Indicator cum reset panel, Outputs to Magnet valve, DMR etc.

Caution: Care should be taken to see that wiring should be followed as per the Inter connection diagram given in the annexure. Any wrong connection may lead to malfunctioning or failure of the equipment.

4.2.2 Installation of VCD Indicator cum Reset Panel

Information : Refer Inter connection diagram in the annexure

Installation Procedure: Cut open the driver's desk to accommodate the VCD Indicator cum reset panel on both the control stands for easy accessibility. Fix the VCD Indicator panels on the given space. Connect the cables from the VCD control unit.

4.2.3 Installation of Electro Magnetic Valve:

Information : Refer Pressure tapping for VCD diagram in the annexure

Installation Procedure: Weld the mounting bracket at a suitable place and fix the magnet valve on the bracket. Proper piping have to be laid and ensure that no leakage takes place at input and output ports.

One of the terminals should be connected to Battery negative (Wire No.4) and other from magnet valve output wire of VCD control unit. Refer carefully VCD interconnection diagram.

4.2.4. Installation of Pressure Switch

Information : Refer Pressure tapping for VCD diagram in the annexure

Installation Procedure: Weld the mounting bracket at a suitable place and fix the pressure switch on the bracket. Proper piping has to be laid and ensure that no leakage takes place at input port.

Open the top cover of the pressure switch and connect Terminal No. 1 of the pressure switch to Battery positive (Wire No.71) and Terminal No.4 should be connected to SA9 input wire of VCD control unit. Refer carefully VCD interconnection diagram.

4.3. COMMISSIONING

Connect the VCD system as per the interconnection diagram. After ensuring the connections thoroughly, Switching ON Battery. The following should happen

- VCD control unit will be active and displays the Penalty Brake counter value
- Penalty Brake output will be OFF and DMR output will be activated
- VCD Indicator cum reset panel will light up VCD Active LED (Blue)
- If the loco is in MU/Trail mode, the MU/Trail LED will glow.
- **Ensure BCP Pressure is greater than 2.3Kg/cm² to suppress VCD operation in a stand still loco.**
- Crank the engine and see to it that all loco operations should reset the VCD cycle.
- In case of any failure in the VCD equipment, break the glass of Bypass switch and put the switch in “ON” position for normal operation of the locomotive.

4.4 INSTALLATION OF ANALYSIS SOFTWARE

Minimum System Requirements for loading the VCD Analysis software

- IBM PC with Pentium-IV processor or above
- Windows XP or later
- VGA card with at least 800 X 1024 resolution & 256 colors.
- Colour Monitor
- 1GB RAM
- Windows Graphics Parallel PRINTER.
- One working USB PORT/RS232 port

PROCEDURE FOR INSTALLATION:

1. Switch on the computer.
2. Go to My computer.
3. Place CD in CD drive. Click on the CD drive.
4. Select the VCD Setup file from the CD Drive.
5. Follow the instructions as they appear on the screen
6. At the end of setup the item LAXVENVCD will be added to the Program menu.
7. To run the program you will have to click this item.
8. You could create a shortcut to appear on the desktop. Clicking this shortcut will also start the program.
9. Creating the Shortcut:
 - (a) Start Windows Explorer
 - (b) Change directory to C:\Program Files\LaxvenVCD
 - (c) Right click the Laxven. Select Create Shortcut.
 - (d) The shortcut will be created in C:\Program Files\LaxvenVCD folder
 - (e) Drag the shortcut on to the desktop
 - (f) To Rename the shortcut right click on it. Select Rename. Change the name of your choice.

For Downloading and Parameter setting refer Annexure -II