MSDAC-730P is a multi section digital axle counter system that is designed using the principles of fail-safety and has a two-out-of-three fail safe architecture. It is microcontroller based and has redundant power supply arrangement. Its modular nature allows you to plan your upgrade and extensions without any problem. It is field extendable with 8 detection points in a module set. It provides an easy to use GUI for configuration.

It is used for detecting railway track occupancy primarily in a station. It is used for track circuiting a whole station. MSDAC-730P is modular in design and can be used with 40 detection points per chassis. Each detection point has a track sensor that identifies a track section boundary. A track section can be defined with 2/3/4 detection points.

The system consists of the following components:

1. Axle Detectors
2. Electronics Field Units
3. Central Evaluator
4. SM's Reset Panel
5. Monitoring Unit

The Central Evaluator of MSDAC-730P has been designed to be modular. The system can be configured for up to 40 field units in steps of 8. Therefore, the system can scale up or scale down according to the requirement at station.

**PRINCIPLE OF WORKING**

The Axle Detectors are installed at the limits of a track section along with their electronic field units on track side. The number of detection points is decided based on the track circuiting requirement of a station. The field units are connected with Central Evaluator by means of ½ Quad cable. The Central Evaluator is installed at the station and is powered by 24V DC local supply. The field units are also powered using 24V DC that is derived from the power source that powers the central evaluator. The Axle Detectors operates on high frequency (21 KHz & 23 KHz) electromagnetic wheel detection technology. When a train wheel passes over the Axle detector, the change in electromagnetic field is sensed. This change triggers a complex algorithm that decides if a wheel has passed over the axle detector as well as the direction of movement. The Axle detectors and the electronics associated with it is working on the principle of Phase Modulation.

The wheel-detection events are converted into pulses and these pulses are counted by the field units. These counts are stored as well here. The stored counts as well as the health of the track sensor are monitored and are continuously transmitted by the field unit by means of telegram packets to Central Evaluator on the ½ Quad cable that also powers the field unit. The central evaluator receives the count from each of the field unit it is connected to and it then takes the decision of the track section is occupied or not. This decision is taken based on 2003 voting logic in a fail safe manner. MSDAC signals the occupancy of the track section by means of an electro-mechanical relay called VR relay. The contacts of VR relay or its repeater are used in the signaling circuits of signalling system at the station.

MSDAC has a mechanism to reset a particular track section to recover from an error or a failure condition. This is done through the SM's reset panel. The section is to be physically verified by the SM to be unoccupied and then the reset command is to be given from the reset panel. This command is received by the central evaluator and it then sends the command to the respective field units to zero their counts. CEL is already working on VDU leased SM’s reset panel and this is expected to be launched in FY 2017-18.
DESIGN FEATURES

i Central Evaluator designed on 2 out of 3 Architecture
ii Designed as per CENELEC, SIL- 4 (European standards).
iii Suitable for connecting maximum of 40 detections, 40 track sections
iv Power & Data to field units on same quad pair.
v Configuration card for Onsite Configuration
vi Vital Relay Drive output for Q type 24V, 1000 ohm.
vii Easy maintainability through modular design.
viii Inbuilt Event Logger card for event logging and report generation.
ix Field upgradable form SDP to 40 DP in steps of 8.
x Dual detection for redundancy possible with same chassis or different chassis.
xi Reduced inventory for Railways as many components of SSDAC are common.

SALIENT FEATURES

i Modular Design.
ii Easy to upgrade in field.
iii User selectable (Hard/Preparatory) resetting.
iv Real time and Remote (Optional) monitoring
v No requirement of power cable to send power to field units. Power and data multiplexed on same line.
vi Inbuilt Event Logger card for offline analysis.
vii Q type 24V, 1000 Ohm 6F/6B vital relay output.
viii No need for trolley protection track circuit.
ix Range of detection points is 4 Km for centralized power supply and 20Kms for local power supply.
x Can be installed on 19” CT Rack/Standard 42U Rack.

CONFIGURATION OF MSDAC

1. The chassis card panel of a few configuration of detection points is shown in this section.

a. Up to 8 Detection Points (DP)

This system is capable of interacting with 8 detection points and can generates max of 8 track sections output.

The front side of 8DP central evaluator consists of following modules

b. 9-16 Detection Points

This system is capable of interacting with 16 detection points and can generates max of 16 track sections output.
c. **17-24 Detection Point**
This system is capable of interacting with 24 detection points and can generate a maximum of 24 track sections output.

d. **23-32 Detection Points**
This system is capable of interacting with 24 detection points and can generate a maximum of 32 track sections output.

e. **33-40 Detection Points**
This system is capable of interacting with 40 detection points and can generate a maximum of 40 track sections output.
2. BACK PANEL
   The back panel of central evaluator is same for all the models of MSDAC and is prewired to cater to 40DP as a standard factory arrangement.

3. The MSDAC can be configured through the Configuration Card as per yard layout in different track sections as under:
   - Two detection points Single section: In straight line.
   - Three/Four detection points Single section: In point zone.
   - Multiple detection points single section: In ladder.
   - Consecutive single section in a straight line: Auto block.
   - Intermediate block signaling

SYSTEM DESCRIPTION
The MSDAC System consists of several components. Some of these components are located in the field and some are at the station, the description of these Components is as follows:

a. Central Evaluator (CE):
   - 2003 Hardware Architecture based Evaluator Module Card (EM08).
   - Relay Driver Card for generating 8 vital outputs.
   - Each set of one EM08 Card & Relay Driver Card can be connected to 8 inputs and generates 8 vital outputs.
   - 5 sets of these modules can be housed in a single 19” Rack
   - Inbuilt event logger for event logging & remote monitoring.
   - Dual DC-DC converter for redundancy.
   - Configuration Card for onsite configuration of Yard Layout.
   - Operates on 24VDC supply.

   ![Figure 6: Central Evaluator](image6)

b. Digital Axle Counter Field Unit (DACFU):
   - Each Unit is configured as a detection point.
   - Detects wheels & stores count based on 2002 logic.
   - Transmits wheel count & health information to CE.
   - 2002 Hardware Architecture.
   - Each field unit is connected to evaluator on half quad cable in star configuration.

   ![Figure 7: Field Unit](image7)

c. Pre-wired Relay Assembly Unit:
   - It is pre-wired relay assembly unit for connecting relays with central evaluator.
Mountable on 19” CT Rack.
- Each unit can house 4 Nos of Q-type 24V, 1000 Ohm Relays.
- Can be upgraded on site as per requirement.

![Pre-Wire Relay Assembly](image8.png)

**Figure 8: Pre-Wire Relay Assembly**

d. Axle Detector:
- Operates on 21KHz and 23KHz frequencies.
- Works on phase modulation principle.
- Web mounted type.
- Unaffected by 4/6 spoke push trolley.

![Axle Detector](image9.png)

**Figure 9: Axle Detector**

e. Reset Panel:
- Section wise indication of Section Clear, Section Occupied, Preparatory Reset & Line Verification.
- SM’s control key.
- Section wise non resettable counter for recording reset.
- Can be customized as per yard layout.

![SM’s Reset Panel](image10.png)

**Figure 10: SM’s Reset Panel**
f. Centralized DC to DC Converter:
- Capable of generating 8/16 channels of 96VDC, required for field units in case of centralized power supply is used.
- Overload/short circuit protection for individual channels.
- Works on 24VDC input supply.

![Figure 11: DC - DC Convertor](image)

**g. Configuration Terminal:**
- User Friendly configuration tool for configuring system in factory or at site.
- Configuration using Windows based GUI tool.
- Can be used with any commercial desktop computer using serial port.

**ORDERING INFORMATION**
Each MSDAC consist of the following subsystem. Different Modules can be picked up with various options for different configurations.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>NO OF CARDS FOR UPTO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DESCRIPTION</strong></td>
<td><strong>MSDAC-730/8DP</strong></td>
</tr>
<tr>
<td><strong>CENTRAL EVALUATOR RACK</strong></td>
<td>19&quot; 20U</td>
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<tr>
<td><strong>CENTRAL EVALUATOR</strong></td>
<td>2 NOS</td>
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<tr>
<td><strong>DC-DC CONVERTER</strong></td>
<td></td>
</tr>
<tr>
<td><strong>EM08 CARDS</strong></td>
<td>1 NO</td>
</tr>
<tr>
<td><strong>RELAY DRIVER CARDS</strong></td>
<td>2 NOS</td>
</tr>
<tr>
<td><strong>CONFIGURATION CARDS</strong></td>
<td>3 NOS</td>
</tr>
<tr>
<td><strong>EVENT LOGGER</strong></td>
<td>4 NOS</td>
</tr>
<tr>
<td><strong>MOTHERBOARD</strong></td>
<td>5 NOS</td>
</tr>
<tr>
<td><strong>DIGITAL AXLE COUNTER FIELD UNIT</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SCC CARD 21 KHZ</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SCC CARD 23 KHZ</strong></td>
<td></td>
</tr>
<tr>
<td><strong>MLB CARD</strong></td>
<td></td>
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<tr>
<td><strong>MODEM CARD</strong></td>
<td></td>
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<tr>
<td><strong>HIGH VOLTAGE DC TO DC CONVERTER CARD</strong></td>
<td></td>
</tr>
<tr>
<td><strong>AXLE DETECTORS</strong></td>
<td></td>
</tr>
<tr>
<td><strong>TX 21 &amp; TX 23</strong></td>
<td>8</td>
</tr>
<tr>
<td><strong>RX 21 &amp; RX23</strong></td>
<td>8</td>
</tr>
<tr>
<td><strong>POWER &amp; DATA COUPLING UNIT</strong></td>
<td>16</td>
</tr>
<tr>
<td><strong>HIGH VOLTAGE DC TO DC CONVERTER</strong></td>
<td>24</td>
</tr>
<tr>
<td><strong>SM’S RESET PANEL</strong></td>
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<tr>
<td><strong>CUSTOMISED YARD LAYOUT</strong></td>
<td>40</td>
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<td><strong>TOOLKIT FOR FIELD UNIT</strong></td>
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<tr>
<td><strong>ADDITIONAL SUBSYSTEMS</strong></td>
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<tr>
<td><strong>PORTABLE DATA ANALYSER</strong></td>
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<tr>
<td><strong>CONFIGURATION TERMINAL</strong></td>
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<tr>
<td><strong>MONITORING UNIT</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>POWER SUPPLY</strong></td>
<td></td>
</tr>
<tr>
<td><strong>BATTERY BANK</strong></td>
<td>24V, AS PER RAILWAY SITE REQUIREMENTS</td>
</tr>
<tr>
<td><strong>BATTERY CHARGER</strong></td>
<td>24V, 30A( AXLE COUNTER TYPE ONLY) OR 50A</td>
</tr>
</tbody>
</table>
POWER CONSUMPTION:
**80W TO 125W FOR 40 DP MODEL**

NOTE: - It is recommended NOT to share the battery & battery charger for 2 Evaluators at same station to hamper the system availability.

STATUS

MSDAC-730 has been approved by RDSO on educational orders of 50 sets.
The MSDAC system of CEL has already worked successfully 70 track section for a total of 709 TS months.

APPLICATION

**1. TRACK CIRCUITING OF STATION YARD**

MSDAC can be used for track circuiting of station yard in lieu of DC Track circuit (where DC Track circuit is not present) or in dual redundancy with DC Track circuit (where DC Track circuit is already present). It can also be used in station yards which are prone to water-logging or flood like conditions.

CONFIGURATION:

Windows Based GUI tool along with Configuration Terminal can be used to configure any yard with options for hard resetting, piloting is required, LV Box is required or not with report generation. The configuration report will be used for validation of configuration data and record purposes at the later stages.

**MSDAC-MODEL DACF-730-16DP**

12DP – 8 Track section MSDAC is sufficient for track circuiting. MSDAC will have 2 EM08 Cards that can be used in UP & DN Line for increased availability.

![](image1.png)

Figure 12: Single Detection Track Circuit Scheme

**MSDAC –MODEL DACF-730-32DP**

Dual Detection by MSDAC may also be achieved by adding detections on left rail and right rail and adding 2 EM08 & RELAY DRIVER modules in the evaluator end.

![](image2.png)

Figure 13: Double Detection Track Circuit Scheme
POWER SUPPLY & CABLE REQUIREMENT:-

POWER REQUIREMENT

◆ 12W per Detection point
◆ 24W for Central Evaluator (16DP Model) & STATION MASTER PANEL

CABLE REQUIREMENT

◆ ½ Quad from Relay Room to each DP.
◆ 2 core 6mm2 or 10mm2 Copper from battery bank to central evaluator & SM’s Room.
◆ 2 core twisted shielded cable from CT Rack to Central Evaluator

2. AUTO SIGNALLING

Figure 14 shows the scheme for using CEL’s MSDAC in Auto Signalling Section

SYSTEM OFFERED – One DACF-730-8DP for UP Line & DN Line at Station A and one DACF-730-8DP at Station B. Dual Redundancy with high availability may be achieved having 2 DACF-730-8DP in one MSDAC Rack.

POWER SUPPLIED TO DP UPTO 4 KMS will be supplied by using High Voltage DC-DC Converter (DC-210) on 24V DC Battery Bank. One additional DC-210 may be kept at intermediate hut that will feed power to DPs beyond 4 kms.

ONE SM’S RESET PANEL will be at Station A and one Reset Panel will be at Station B having provision for all the track sections.

CABLE REQUIREMENT

◆ 4Q for UP Line for DP-1 to DP7 from Station A & DP9 & 4Q for UP Line from Station B for DP8, DP9 to DP16.
◆ 4Q for DN Line for DP-1 to DP7 & DP9 from Station B & 4Q for UP Line from Station A for DP8, DP9 to DP16.
◆ 1Q for Cooperative Reset from Station A & Station B

3. IBS Signalling

Figure 15 shows the scheme for using CEL’s MSDAC for IBS application

SYSTEM OFFERED

DACF-730-8DP model with Dual CE-501-8DP in Single rack may be used. For High reliability with dual detection can be used by using spare DP connections in the same scheme or using 4 separate 8 DP module installed in same evaluator or 2 or 4 evaluators. The local power will be used to power on DP’s from IB Hut by using one High Voltage DC-DC Converter.

Dual DP will be used for generating relay output ‘O’ in UP Line & ‘R’ in DN Line. The intermediate DP’s will be of Dual DP that will interact with Evaluators at both end.
Figure 14: Use of MSDAC for Auto Signalling
INTERMEDIATE SIGNALLING USING MSDAC

Figure 15: Use of MSDAC for IBS
Scheme of Block Operation with 2.4 GHz Digital Microwave Radio

The Block Instrument is connected to the fail-safe multiplexer - UFSBI using signalling or PIJF cable, so that DC and FM signals are exchanged between them reliably. The UFSBI is subsequently connected to the communication media, i.e. Microwave Radio directly through RS232C data port DB9 connector (@ 2.4 Kbps).

For instance, when a bell plunger of the SGE DLBI or Diodo TLBI is pressed the DC signal generated from the Block Instrument, is used to energize an input relay at one end, which is transmitted to the other end through the communication media via modem to the other end, and subsequently picks up an output relay. The output relay is used to commutate the local DC supply to the receiving end Block Instrument, as if it is connected to the other machine using copper cable and thereby completes the DC current loop.

In order to perform the inter-station voice communication the Radio provides an Ethernet port. A VOIP adaptor is used to interface between the conventional E&M phones used in railways and the IP port of radio, thus providing toll quality secured voice communication.

Fig 1. System Layout of Block Working on Microwave Radio using UFSBI (as per RDSO/SPN/147/2005) including secured Voice Communication