SHREE GANESH ENTERPRISES
NEW DELHI · AMC MEP 24x7 · sge.org.in

DOC: SGE-EB-2026-06

E-BOOK 06 INTERMEDIATE EDITION

Fire Alarm Design & Cable Calculation Guide

Conventional and Addressable Systems, Detector Selection and Loop Cable Sizing

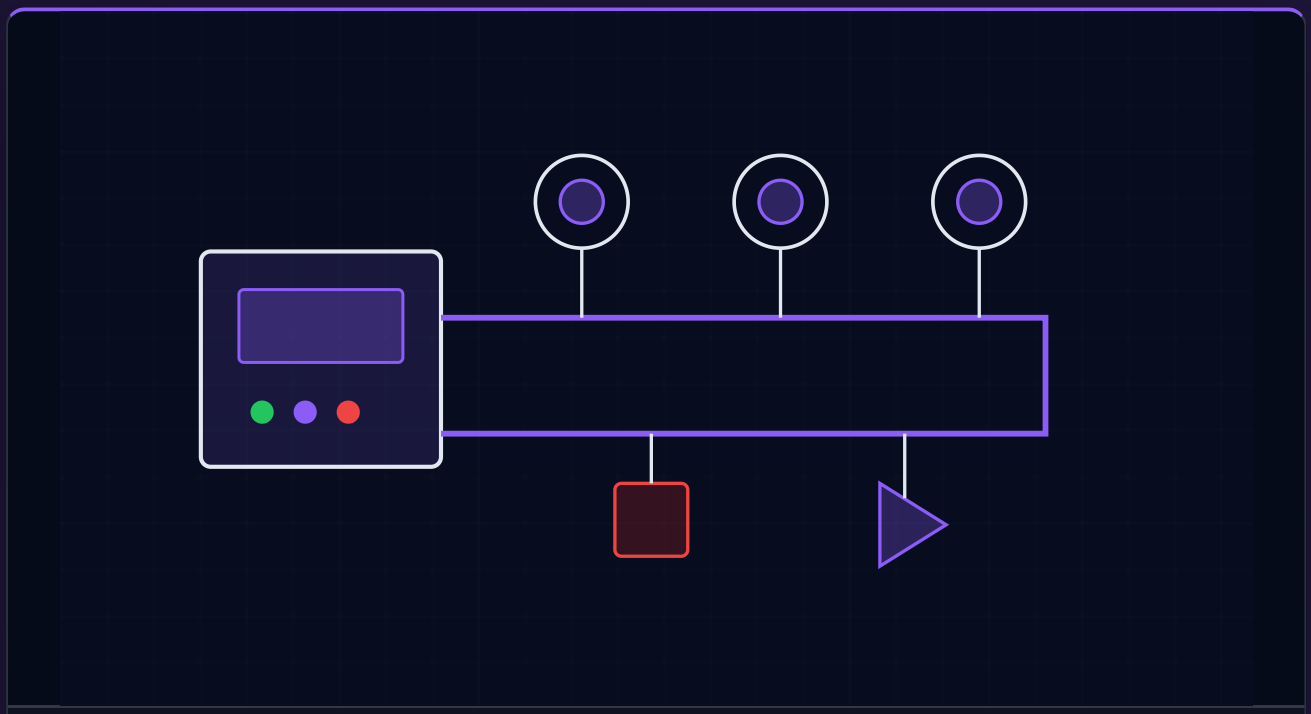


FIG 06.1 — ADDRESSABLE FACP CLASS-A LOOP & VOLTAGE-DROP TOPOLOGY

SYLLABUS
10 Structured Chapters

CALCULATIONS
Worked SI Examples & Tables

SITE READY
Forms & Hinglish Glossary

Shree Ganesh Enterprises (SGE) — AMC MEP 24x7
Fire Fighting · Fire Alarm · Electrical · Plumbing · HVAC · IBMS · AMC

1st Edition, 2026
sge.org.in/ebooks/fire-alarm-design-cable-calculation

Fire Alarm Design & Cable Calculation Guide

Conventional and Addressable Systems, Detector Selection and Loop Cable Sizing

A complete practical design and cable calculation guide for fire detection and alarm systems (FDAS), comparing conventional zone wiring with addressable Class-A loops, detailing space-by-space detector selection, 24V NAC sounder voltage drop arithmetic, standby battery sizing, MEP interfaces, and false-alarm prevention.

Intended Audience: ELV / Fire Alarm design engineers, commissioning technicians, electrical site supervisors, and facility maintenance leads.

Engineering Notice & Standards Policy

This publication is an educational and field-reference guide prepared by **Shree Ganesh Enterprises (SGE)**. It is **not** a substitute for a stamped project design, statutory approval, or the governing text of the National Building Code of India (NBC), Bureau of Indian Standards (BIS) codes, Indian Electricity Rules / CEA Regulations, or your State/Municipal Fire Service Bye-Laws. Standards are cited at document level; always verify the **current applicable edition**, manufacturer datasheets, and local amendments before design, procurement, testing, or certification.

Worked numerical examples across this book are illustrative engineering demonstrations. All design inputs, pipe friction factors, battery deratings, and protective clearances must be re-checked for project conditions by a competent licensed professional. High-voltage electrical testing, pump-room servicing, and gaseous fire suppression operations can be fatal if undertaken without qualified personnel, written Permits-to-Work, and Lockout-Tagout (LOTO) controls.

Roman-script Hindi/Hinglish site terms are included cleanly to assist execution teams; formal English engineering terminology governs contractual and code interpretations.

Copyright & Licensing

© 2026 Shree Ganesh Enterprises (SGE). All rights reserved. No part of this manual may be reproduced, redistributed, or resold publicly without written authorization. Licensed strictly for purchaser and internal engineering team reference.

Publisher: Shree Ganesh Enterprises (SGE) — AMC MEP 24x7 | **Web:** sge.org.in | **Support:** support@amcmep.in

Contents

01 Chapter 1: Fire Detection Architecture — Conventional vs Addressable

02 Chapter 2: Detector Types and Space-by-Space Selection Matrix

03 Chapter 3: Manual Call Points, Hooters/Strobes, Response Indicators and Modules

04 Chapter 4: Detector Coverage, Ceiling Height and Spacing Calculations

05 Chapter 5: Panel Sizing, Loop Capacity and Standby Battery (Ah) Calculation

06 Chapter 6: Fire Cable Selection, Shielding and Voltage-Drop Calculation

07 Chapter 7: Critical Life-Safety Cause-and-Effect Matrix (Interfaces)

08 Chapter 8: Installation Hygiene, Conduit Segregation and False-Alarm Prevention

09 Chapter 9: Commissioning, Weekly/Quarterly Test Schedule and Point Schedule

10 Chapter 10: Cheat Sheet, FAQ and Hinglish ELV Glossary

What You Will Learn

- Contrast Conventional Zone (Class-B EOL) wiring with Addressable (Class-A SLC) loop isolation topologies
- Select the correct Optical Smoke, Fixed/RoR Heat, Multi-Criteria, Beam, and Duct detector for each room hazard
- Position Manual Call Points, sounder-strobes, and response indicators accurately across floor layouts
- Calculate 24-hour standby + 30-minute alarm VRLA battery capacities with temperature/ageing factors
- Calculate 24V DC sounder/notification circuit voltage drop (mV/Ohm) to avoid silent far-end hooters
- Wire life-safety interfaces (lift homing, AHU tripping, stair pressurisation, access-door release) cleanly

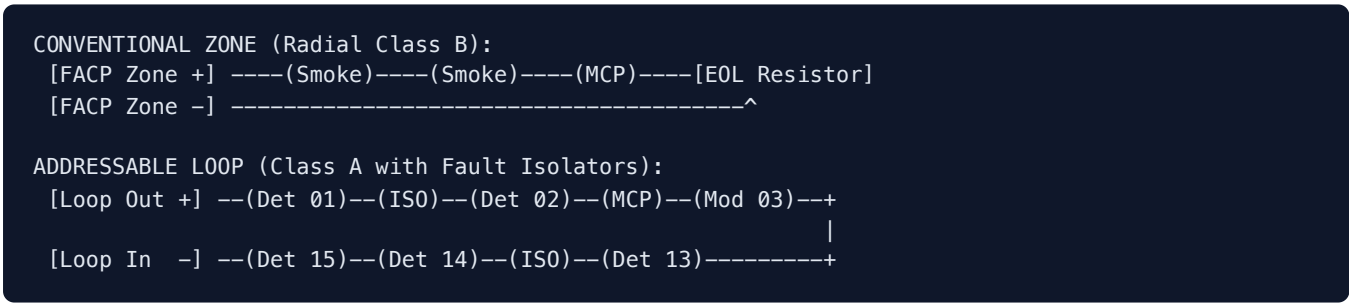
Chapter 1: Fire Detection Architecture — Conventional vs Addressable

Catching Fire in Minutes Rather Than Waiting for Flames

A sprinkler needs ~68 C ceiling heat to burst; by that time smoke already fills hallways. An engineered **Fire Detection and Alarm System (FDAS)** detects microscopic combustion aerosols or rapid heat rises within seconds, alerts occupants immediately, and triggers building ventilation/lift safety controls.

Conventional vs Addressable Architecture

Parameter	Conventional FDAS	Addressable FDAS
Wiring Topology	Radial 2-wire Zone (`EOL` End-of-Line Resistor at last device)	Looped 2-wire **Signaling Line Circuit (SLC)** returning to panel (Class A)
Location Visibility	Panel shows only **"Zone 2 Fire"** (entire floor/wing)	Panel displays exact **"L1-D042 Server Room Smoke"**
Fault Tolerance	Single cut opens detectors downstream of break	With **Fault Isolator Modules**, both halves keep working cleanly from opposite ends!
Cost Profile	Economical for small shops, clinics, tiny hostels (< 20–30 devices)	Standard choice for multi-storey offices, hospitals, factories, hotels



NOTE

System design rules, spacing distances, sounder decibel levels, and battery hold hours depend on IS 2189, NFPA 72, EN 54, and NBC 2016 Part 4. Confirm the current code edition and product approvals before purchase.

HINGLISH

Conventional = poore area ka ek zone batane wala panel. Addressable = har ek detector ka exact kamra number batane wala smart panel. EOL Resistor = zone line ke aakhiri chhor par lagne wala monitoring resistor.

Chapter 2: Detector Types and Space-by-Space Selection Matrix

Picking Smoke vs Heat Prevents Nuisance Alarms

Mounting an optical smoke detector inside a dusty welding bay or steamy commercial kitchen triggers nuisance sirens daily—causing security guards to mute or disconnect the whole panel! Match sensor physics to room environment cleanly:

Building Space	Recommended Detector	Why This Choice Works	Avoid Placing Here
Offices, Corridors, Bedrooms	Photoelectric / Optical Smoke	Responds rapidly to smouldering plastic/paper smoke	Heavy dust streams near doors
Commercial Kitchens & Tea Pantries	Fixed Temperature Heat (~57–60 C)	Ignores cooking steam/frying fumes; triggers on true flame heat	Optical smoke detectors
DG Rooms & Car Basements	Rate-of-Rise (RoR) + Fixed Heat or Multi-Sensor	Ignores mild exhaust haze while catching petrol/diesel flash heat	Pure sensitive optical smoke right over tailpipes
High Atriums / Warehouses (> 10 m)	Projected Beam Smoke Detectors	Covers long 50–100 m spans where point heads lose stratification	Maintenance-unfriendly high ceiling spot heads
Server Rooms / Data Centres	Multi-Criteria + Aspirating (ASD)	Sub-minute early warning inside chilled air streams	Slow fixed-temperature heat heads
AHU Supply/Return Ducts	Duct Smoke Sampling Housing	Shuts HVAC fan before smoke pumps to every non-fire floor	Normal unprotected ceiling head inside 10 m/s wind

HINGLISH

Optical smoke = dhuen ko dekhne wala sensor. Rate-of-Rise Heat = kamre ki garmi tezi se badhne par bajne wala heat sensor. Duct detector = AC hawa ki pipe ke andar dhuan pakadne wala yantra.

Chapter 3: Manual Call Points, Hooters/Strobes, Response Indicators and Modules

Peripheral Field Devices Explained

1. **Manual Call Points (MCPs):** Red break-glass / resettable-element call boxes mounted along escape corridors and staircase entry doors at convenient reach height (typically ~1.4 m above floor, max walking distance usually ~22.5–30 m per standard).
2. **Sounders / Hooters & Visual Strobes (NAC Circuits):** Alert occupants clearly above background machine noise (minimum audible dB margin above ambient across occupied bays; flashing strobes mandatory in noisy plant rooms or accessible toilets!).
3. **Remote Response Indicators (RIs):** Tiny red wall LEDs wired cleanly to concealed detectors sitting *above false ceilings* or inside locked store cupboards—so responders spot which ceiling void tile triggered without

lifting 40 tiles!

4. **Monitor & Control Modules:** Interface addressable SLC loops cleanly to sprinkler flow switches, ZCV tamper switches (Monitor), or lift homing & AHU damper trip relays (Control).

Chapter 4: Detector Coverage, Ceiling Height and Spacing Calculations

Spacing Logic for Flat, Partitioned and Void Spaces

Typical point detector coverage rules (confirm exact figures against IS 2189 / NFPA 72):

- **Point Smoke Detector (Flat ceiling <= 3 m):** Often taken as ~7.5 m effective radial reach (roughly **50–100 m2 max area** per detector depending on code standard & spacing layout; practical clean layout commonly assumes ~50–60 m2 for reliable fast response and corridor width overlaps).
- **Point Heat Detector:** Smaller effective reach (~5.3 m radius or roughly **25–50 m2** area) because heat plumes rise tighter than cooled smoke plumes.
- **False Ceiling Void / Underfloor Void:** Where hidden cable/dust void height exceeds threshold (commonly >= ~800 mm or containing combustible cables per code), provide extra detectors in the void linked to wall RIs!
- **Deep Structural Concrete Beams:** Beams exceeding ~10–15% of ceiling height trap smoke inside bays; treat each deep bay as an independent compartment or reduce spacing cleanly.

WORKED EXAMPLE 1

Floor Smoke Detector Estimation (Illustrative). Open-plan office floor = **900 m2** (30 m x 30 m), flat gypsum ceiling at 3.2 m height with negligible plenum void. Adopting a conservative effective coverage assumption of **50 m2 per optical smoke detector** (check exact code allowance for your building):

Estimated open-area detectors = 900 m2 / 50 m2 = **18 optical smoke detectors**. Grid layout Check: 6 columns spaced @ 5.0 m (= 30 m) x 3 rows spaced @ 10.0 m? Better balanced grid: **6 x 3 = 18** would have 10 m row spacing (exceeds typical 7.5–9 m code center limits!). Instead adjust to a symmetrical **4 rows x 5 columns = 20 detectors** (6.0 m x 7.5 m spacing = 45 m2/head; max half-diagonal to corner = `sqrt(3^2 + 3.75^2) = 4.80 m`, comfortably inside ~7.5 m max radius!). Always verify geometry diagonally, not merely area division!

HINGLISH

Response Indicator (RI) = false ceiling ke upar lage chhupe detector ka bahar deewar par laga red signal lamp.

Chapter 5: Panel Sizing, Loop Capacity and Standby Battery (Ah) Calculation

Always Leave Loop & Power Spare Capacity

- **Addressable Loop Sizing:** If manufacturer loop limit is 127 or 250 addresses, **never load beyond 75–80% on day one** (e.g., cap design count around ~95–100 addresses on a 127-point loop) to leave clear expansion