

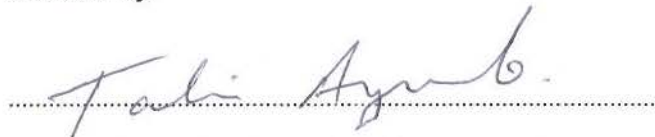
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Issue:	1
Date:	6 th June 2015
Compliance date:	6 th June 2015

Level 2

Product Specification for Distribution Interface Transformer Assemblies (DITA) for Signalling Power Distribution Systems

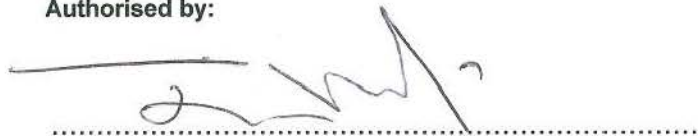
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Published and Issued by Network Rail, 2nd Floor, 1 Eversholt Street, London, NW1 2DN

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User information

This Network Rail standard contains colour-coding according to the following Red–Amber–Green classification.

Red requirements – No deviations, could stop the railway

- **Red requirements shall** always be complied with and achieved.
- Red requirements shall be presented in a red box **with the word “shall” or expressed as a direct instruction**.
- Accountability for the efficacy of red requirements lies with the Professional Head/Standard Owner.
- Red requirements are monitored for compliance.
- Corrective actions shall be enforced if deviations are discovered through functional checks (e.g. engineering verification visits, audit or Operations Self-Assurance).

Amber requirements – Controlled deviations, approved risk analysis and mitigation

- **Amber requirements shall** be complied with unless deviation has been approved in advance.
- Amber requirements shall be presented with an amber sidebar **and with the word “shall” or expressed as a direct instruction**.
- Accountability for the efficacy of these requirements lies with the Professional Head/Standard Owner, or their nominated Delegated Authority.
- Amber requirements are monitored for compliance.
- Deviations **may** be permitted. Deviations are approved by the Standard Owner or through existing Delegated Authority arrangements.
- Corrective actions shall be enforced if **non-approved** deviations are discovered through functional checks (e.g. engineering verification visits, audit or Operations Self-Assurance).

Green – Guidance

- Guidance is based on good practice. Guidance represents supporting information to help achieve **Red** and **Amber** requirements.
- Guidance shall be presented with a dotted green sidebar **and with the word “should” (usually in notes) or as a direct instruction**.
- Guidance is **not mandatory** and is not monitored for compliance.
- Alternative solutions may be used. Alternative solutions do not need to be formally approved.
- Decisions made by a competent person to use alternative solutions should be backed up by appropriate evidence or documentation.

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Issue record

Issue	Date	Comments
1	06/06/2015	First issue

Compliance

This Network Rail standard is mandatory and shall be complied with by Network Rail and its contractors if applicable from 06/06/2015.

When this standard is implemented, it is permissible for all projects that have formally completed GRIP Stage 3 (Option Selection) to continue to comply with the issue of any relevant Network Rail standards current when GRIP Stage 3 was completed and not to comply with requirements contained herein, unless stipulated otherwise in the scope of this standard.

Reference documentation

BRS SM 440 Sheet 4	Standard apparatus case G.A. of small case framework typical example
BRS SM 440 Sheet 5	Standard apparatus case G.A. of large case framework typical example
BS EN 50121-5	Railway applications. Electromagnetic compatibility. Emission and immunity of fixed power supply installations and apparatus
BS EN 50124-1+A2: 2005	Railway applications. Insulation coordination. Basic requirements. Clearances and creepage distances for all electrical and electronic equipment
BS EN 50125-3: 2003	Railway applications. Environmental conditions for equipment. Equipment for signalling and telecommunications
BS EN 60085: 2008	Electrical insulation. Thermal classification
BS EN 60317-0-3	Specification for particular types of winding wires. General requirements. Enamelled round aluminium wire
BS EN 60529+A2: 2013	Degrees of protection provided by enclosures (IP code)
BS EN 60664-1: 2007	Insulation coordination for equipment within low-voltage systems. Principles, requirements and tests
BS EN 61140+A1: 2006	Protection against electric shock. Common aspects for installation and equipment
BS EN 61238-1	Compression and mechanical connectors for power cables for rated voltages up to 36 kV ($U_m = 42$ kV). Test methods and requirements
BS EN 61439-1	Low voltage switchgear and controlgear assemblies – General rules

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BS EN 61439-2	Low voltage switchgear and controlgear assemblies – Power switchgear and controlgear assemblies.
BS EN 61557-8	Electrical safety in low voltage distribution systems up to 1,000 V a.c. and 1,500 V d.c. Equipment for testing, measuring or monitoring of protective measures. Insulation monitoring devices for IT systems
BS EN 61558-1: 2007	Safety of power transformers, power supplies, reactors and similar products. General requirements and tests
BS EN 61857-22: 2008	Electrical insulation systems. Procedures for thermal evaluation. Specific requirements for encapsulated-coil model. Wire-wound electrical insulation system (EIS)
BS EN ISO 9001: 2008	Quality management systems. Requirements
BS EN ISO 10007: 2003	Quality management systems. Guidelines for configuration management
Directive 2006/95/EC	Low voltage directive (LVD) 2006/95/EC
MIL-DTL-5015	Circular bayonet connectors for military, industrial and transportation applications
NR/L2/RSE/100/05	Product introduction and change (formerly NR/L2/EBM/029)
NR/L2/SIGELP/27409	Product specification for functional supply points (FSP)
NR/L2/SIGELP/27421	Product specification – flexible conduits for Class II based signalling power distribution systems
NR/L2/SIGELP/27422	Product specification – cable glands for use in Class II based signalling power distribution systems
VG 95234	Electrical connectors and plug-and-socket devices – Connectors with bayonet coupling, pressure-water tight, up to 245 A

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1 Purpose

This specification defines the requirements for the design, installation, integration and testing of distribution interface transformer assemblies (DITA) into Network Rail managed infrastructure.

The purpose of this specification is to clearly define to manufacturers the performance requirements of a complete DITA and its modules, and to inform power distribution designers who wish to use the design topology of a DITA, and potentially some equipment that already exists, but need to verify that the existing equipment meets the requirements for incorporation into a DITA arrangement.

2 Scope

This specification defines the electrical and mechanical requirements for a DITA. A DITA may be used in signalling power distribution systems, where the nominal supply voltage is up to and including 650 V a.c. and where the electrical systems are either TN or IT, for power ratings up to and including 20 kVA. The specification also outlines the configurations within which DITAs may be used to create a complete assembly.

For reference, Figure 1 shows a schematic representation of a DITA.

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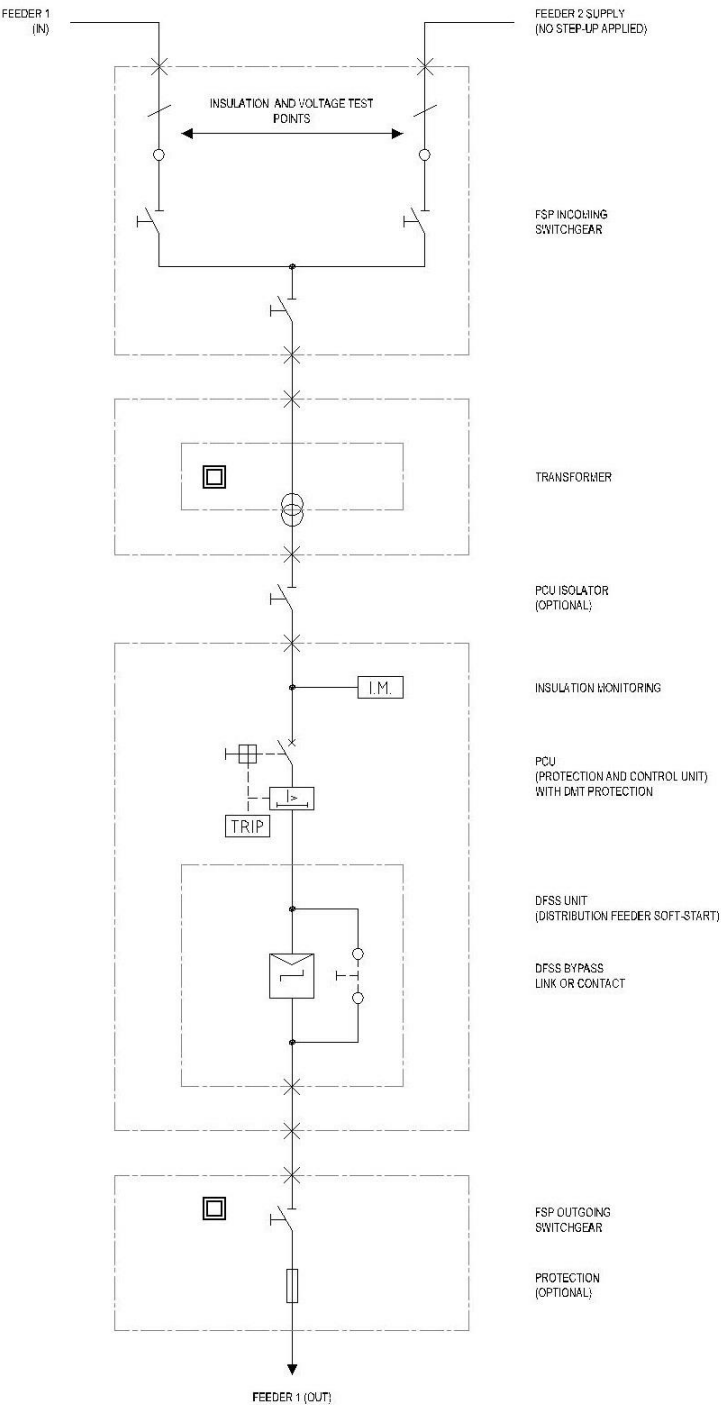


Figure 1 – Schematic representation of a DITA

Note 1: The circuit which provides power to the protection and control unit is not shown.

3 Definitions

Apparatus housing External weatherproof housing which may be referred to as a location case, signalling equipment housing, cubicle, shelter, container or building.

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Class I transformer	Transformer in which protection against electric shock does not rely on basic insulation only, but includes an additional safety precaution such as a protective earth terminal, provided for the connection of accessible conductive parts to the protective earth conductor in the fixed wiring of the installation, so that accessible conductive parts cannot become live in the event of a failure of the basic insulation in accordance with BS EN 61558-1:2007.
Class II transformer	Transformer with basic insulation as provision for basic protection, and supplementary insulation as provision for fault protection or in which basic and fault protection are provided by reinforced insulation, in accordance with BS EN 61140.
Class II hybrid transformer	Transformer in which the primary side, including its terminals, meet the requirements for Class II and the secondary side meets the requirements for Class I, allowing ready access to the secondary tapplings for adjustment in service as defined in NR/L2/SIGELP/30007.
Definite minimum time protection device (DMT)	An electronic protective device with adjustable disconnection time and current characteristics which remain constant throughout its operating range.
Distribution interface transformer assembly (DITA)	Transformer assembly in accordance with this standard. Assembly consists of switchgear, isolating transformer and protection and control unit (PCU).
Function supply point (FSP)	The point that the power supply distribution system connects with an item of supplied equipment and may be co-located with signalling equipment.
Intermateable	The characteristic of like connectors in which one half of one manufacturer will mate directly with the connector of another manufacturer.
Principal supply point (PSP)	The point that the power supply distribution system connects with an item of supplied equipment and may be co-located with signalling equipment. The designation 'PSP' is taken to include other primary supply sources such as auxiliary supply points (ASP) and signalling supply points (SSP).
Nominal supply voltage	The nominal output voltage derived from the PSP output that is connected to the primary; e.g. a supply sourced from a 650 V PSP shall be considered to have a rated supply voltage of 650 V.
Receptacle	Mating half of a connector pair designed to be mounted to a bulkhead, panel or box. A receptacle mates with a plug.

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4 Symbols and abbreviations

A	Amps
a.c.	Alternating Current
ARTmean	Active Repair Time (mean)
ARTmax	Active Repair Time (maximum)
ASP	Auxiliary Supply Point
CE	Conformité Européene
d.c.	Direct current
DITA	Distribution Interface Transformer Assembly
DMT	Definite Minimum Time
DFSS	Distribution Feeder Soft Start
EIM	Electrical Insulating Material
EIS	Electrical Insulating System
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
FSP	Functional Supply Point
Hz	Hertz
IM	Insulation Monitor
IP	Ingress Protection
kg	kilo-grams
kVA	kilo-Volt-Amperes
MET	Main Earth Terminal
mm	millimetre
mm²	millimetres squared
ms	milli-second
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
O&M	Operations and Maintenance (manual)
PCU	Protection and Control Unit
PSP	Principal Supply Point
RAM	Reliability Availability Maintainability
RCM	Remote Conditioning Monitoring
rms	root mean square
SELV	Separated Extra Low Voltage

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SSP	Signalling Supply Point
UV	Ultraviolet
V	Volts
Ω	Ohms
°C	Degrees Celsius

5 DITA system overview

A DITA (distribution interface transformer assembly) is a switchgear assembly consisting of an arrangement of interconnected modules that can be used for specific applications as detailed in section 6.

5.1 DITA components

A DITA may consist of some or all of the following.

- a) Switchgear – the switchgear and associated protective devices required to interface the DITA with the electrical system. The switchgear would usually be a separate assembly installed within the same apparatus housing, REB or PSP.
- b) Transformer – the transformer section of the DITA may contain the incoming isolating transformer(s) and the main isolating device for the DITA system. The transformer(s) may be single- or three-phase arrangement, depending on system requirements.
The main isolating device shall be suitable for disconnecting all sources of supply.
- c) PCU (protection control unit) isolator – an intermediate isolator, installed between the isolating transformer and the PCU. This isolator is optional and may form part of a DITA module or the switchgear assembly.
Where fitted, the PCU isolator shall isolate all sources of supply to the PCU, including auxiliaries, simultaneously.
- d) PCU – protection control unit containing the DMT electronic circuit protection for the DITA system, insulation monitoring, distribution feeder soft start (DFSS), DFSS bypass, alarms and auxiliary power supplies.
- e) DMT – electronic circuit protection within the PCU, programmable with a definite minimum time characteristic for circuit disconnection in the event of a fault.
- f) Insulation monitoring device – a device within the PCU to monitor the insulation integrity of the DITA output circuits.
- g) DFSS – distribution feeder soft start, an electronic device within the PCU (or a separate module) for limiting the initial inrush of load current.
- h) DFSS bypass – the facility to be closed manually, allowing complete bypass of the DFSS module.

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NOTE 1: The DFSS may be beneficial where the DITA is installed towards the end of high loop impedance feeders.

- i) DFSS alarms – for each output feeder, alarms shall be provided to indicate fault conditions.

6 System applications

DITAs in accordance with this standard can be used in signalling power distribution systems for the following purposes:

- a) Segregation between a Class I and a Class II installation to preserve the integrity of a Class II based feeder when interfaced with a Class I feeder as shown in Figure 5.

NOTE 1: This is critical where the Class I system has been installed for a number of years and may not be compliant with the requirements of BS 7671.

NOTE 2: This would equally apply if a Class I installation was the source and a Class II installation was installed downstream.

- b) Segregation between feeders and spurs or branches to divide a signalling power system feeder into sections, particularly long feeders or those having multiple spurs or branches as shown in Figure 6.

NOTE 1: To segregate distribution feeders supplied by the PSP, from a single isolating transformer serving a network, to individual isolating transformers for each feeder.

NOTE 2: To segregate distribution feeders by dividing an existing feeder into electrically smaller sections.

- c) To step-up the voltage (voltage boost).
- d) First fault current reduction (FFCR).

NOTE 1: First fault current reduction reduces capacitance by dividing an existing network into electrically smaller circuits. In legacy systems, FFCR may be used in combination with earthing to reduce the target local earth electrode values to acceptable values. This allows the network length to be reduced and hence the target earth electrode value, for each feeder, to be increased. This may be beneficial in installations where soil conditions and access arrangements make it difficult to construct earth farms.

NOTE 2: FFCR is not precluded from use in distribution systems where the retrofit of Class II assemblies and site applied supplementary (Class II) insulation are adopted.

- e) To minimise the flow of stray traction current between different designs of a railway traction system with different traction earthing arrangements, e.g. at the interface between an auto transformer traction system and classical a.c. traction system, between a.c. and d.c. traction systems, or between a traction power system and a non-electrified area.

NOTE 1: If correct isolation is not provided, stray d.c. traction currents could flow through a signalling system earthing arrangement at apparatus housings, causing electrolytic corrosion.

Where a DITA is installed in a circuit in accordance with this standard, it is a 'load' for the upstream circuit and the 'source' of the downstream circuit. As the DITA becomes the new source, circuit protection shall be installed at the output of the DITA for protection of the downstream circuit.

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The DITA will isolate the insulation monitoring system at the PSP from the circuit downstream of the isolating transformer. Insulation monitoring shall be provided in the downstream circuit.

NOTE 1: This is to protect and monitor the status of feeders on the secondary side of the DITA.

NOTE 2: Provision of isolation in a signalling feeder prevents the source PSP insulation monitor from detecting the condition of a feeder beyond the isolating transformer.

NOTE 3: Existing installations with a Class I booster transformer acting as a 'step up' transformer should be replaced with a Class II Hybrid DITA.

Where a DITA is installed for circuit segregation, protection shall be designed to manage low prospective fault currents and high current surges from signalling equipment (transformers, point motors etc.).

Where a DITA is introduced into a signalling distribution system feeder, it shall be limited to radial topologies.

7 DITA system requirements

7.1 Switchgear compatibility

Incoming and outgoing switchgear shall be compatible with, and constructed in accordance with, Network Rail specification NR/L2/SIGELP/27409.

Note 1: As DITA assemblies have integrated protection devices, there is no requirement for additional short-circuit protection to be fitted on the incoming side of this type of switchgear assembly where the feeder source fuse is 32 A or less.

The isolating transformer shall always be co-located with the PCU unless the size of the transformer prevents housing both units in a standard apparatus housing impractical.

Where the prospective fault current is small, consideration shall be given for providing an electronic protective device with a DMT characteristic.

For DITA output protection, a BS 88 protective device shall be provided in series with the electronic protective device when the full prospective fault current for the intended application exceeds the capability of the electronic protective device.

Note 2: A BS 88 fuse fitted in series with the electronic protection device has a faster response time and is more suited to rapid disconnection of high current faults.

7.2 Construction and test

The DITA assembly shall be designed, constructed and tested in accordance with BS EN 61439-2 and BS 7671. The assembly shall be CE marked where applicable with certification detailing compliance to the relevant standards.

Manufacturers shall conduct testing on all new DITA assemblies. These tests may be conducted by external authorities or internally provided that the manufacturer has the necessary expertise to conduct the tests. Prototype testing shall be in accordance with BS EN 61439-1. All test results shall be compiled and submitted in accordance with the product acceptance procedure.

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Manufacturers shall establish a routine test regime for production units. This regime shall be documented and used by competent individuals. The tests will be conducted in accordance with NR/L2/SIGELP/27409 and include visual, mechanical and electrical tests.

Note 1: Manufacturers will be subject to Network Rails' National Supply Chain auditing which includes a technical section designed to review manufacturers' factory acceptance testing (FAT).

7.3 Plug-couplers

Receptacles and plugs shall:

- a) be derivatives of series MIL-DTL-5015;
- b) be reverse bayonet;
- c) have inserts and pin mating configuration in accordance with VG 95234.

Contacts used in either plugs or receptacles that contain energised circuits shall be female, i.e. have 'socket' contacts into which pin contacts engage when mated.

Contacts used in either plugs or receptacles that contain non energised circuits shall be male, i.e. have 'pin' contacts into which 'socket' contacts engage when mated.

Note 1: Current limited SELV alarm priming voltages may be present on male pins of PCU auxiliary output connector.

Plugs shall always be intermateable with their intended receptacles.

Where plug-couplers are used to interconnect a voltage equal to the nominal voltage rating of the feeder, and those connections are not intended for live disconnection, a tamper reminder guard or locking mechanism shall be provided.

7.4 Earth bar

A main earth terminal (MET) shall be provided in accordance with specification NR/L2/SIGELP/27409.

The transformer functional earth shall be connected to the MET and to the earthing system.

Note: This function of the electromagnetic compatibility (EMC) screen on the transformer provides the following functions:

- prevents transfer voltage between primary and secondary from occurring in the event of insulation breakdown between cores;
- allows the primary transformer fuse to rupture under winding-to-winding fault;
- provides a screen to enhance EMC performance.

7.5 Isolating transformer power ratings

DITAs shall be available in ratings up to and including 20 kVA subject to a tolerance of ± 0.5 kVA.