



TECHNICAL REPORT

Electrical installations in ships – Electromagnetic compatibility – Optimising of cable installations on ships – Testing method of routing distance

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

P

CONTENTS

FOREWORD.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references	6
3 Terms and definitions	6
4 Principle	7
4.1 General.....	7
4.2 Reference ground.....	8
4.3 Signal detector (SD).....	8
4.4 Susceptible (drain) cable.....	8
4.5 Interfering (source) cable	8
4.6 Burst generator	8
5 Test set-up	8
5.1 Susceptible interference threshold	8
5.2 Cable routing and distances	8
6 Test.....	9
6.1 General.....	9
6.2 Test performance	10
6.3 Test result	10
Annex A (informative) Test Report: Performance of a routing optimising test	11
Bibliography.....	16
Figure 1 – Routing distance and routing height	9
Figure 2 – Test set-up 1: Unshielded susceptible cable.....	9
Figure 3 – Test set-up 2: Shielded susceptible cable	10
Figure A.1 – Test site with reference ground.....	12
Figure A.2 – Burst injection into interfering cable	14
Figure A.3 – Signal detector (SD)	14
Figure A.4 – Signal detector (SD), block diagram.....	15
Table 1 – Cable categories	7
Table A.1 – Examples for test facilities	11
Table A.2 – Measured interference threshold values versus separation, height and type of susceptible cable	13

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRICAL INSTALLATIONS IN SHIPS –
ELECTROMAGNETIC COMPATIBILITY –
OPTIMISING OF CABLE INSTALLATIONS ON SHIPS –
TESTING METHOD OF ROUTING DISTANCE**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 62482/TR, which is a technical report, has been prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
18/1030/DTR	18/1041A/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

In accordance with IMO-Resolution A.694/6.1: *“All reasonable and practicable steps shall be taken to ensure electromagnetic compatibility between the equipment concerned and other radio communication and navigational equipment carried on board in compliance with the relevant requirements of chapters III, IV and V of the SOLAS Convention.”*

To fulfil this requirement it is necessary to survey the chosen cables and cable installation with regard to EMC.

Basic rules for cabling in international shipbuilding are presently specified in the series of standards given in IEC 60092 [1]¹, requirements on dimensions of routing distances in cable systems are given in IEC 60533 and basic requirements on cable routing in IEC 60092-352. As the requirements differ between the relevant documents, the question of validity has been discussed internationally. This applies particularly in regard to parallel routing of power electronics cables on the one hand and measuring and control equipment cables on the other hand.

General Information about routing distances is mainly based on the German standard VG 95375-3 [4]. This standard is based on tests performed in 1982 [2].

In those days tests were performed mainly with sinusoidal signals in the frequency range of 0.1 MHz up to > 40 MHz and even today there is no reason to doubt these test results. However, the question has often been raised whether these results are also adequate for unacceptable crosstalk into cables for integrated digital circuits. In no case fast transients may affect the function inadmissibly where interference thresholds should be a maximum. The measurements were accomplished to investigate this issue.

¹ Numbers in square brackets refer to the Bibliography.

ELECTRICAL INSTALLATIONS IN SHIPS – ELECTROMAGNETIC COMPATIBILITY – OPTIMISING OF CABLE INSTALLATIONS ON SHIPS – TESTING METHOD OF ROUTING DISTANCE

1 Scope

This Technical Report describes tests methods carried out to determine minimum routing distances in order to avoid crosstalk of fast transients (bursts). The test results may be applied to cable installations according to IEC 60092-352.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60092-352, *Electrical installations in ships – Part 352: Choice and installation of electrical cables*

IEC 60092-353, *Electrical installations in ships – Part 353: Single and multicore non-radial field power cables with extruded solid insulation for rated voltages 1kV and 3 kV*

IEC 60092-374, *Electrical installations in ships – Part 374: Shipboard telecommunication cables and radio-frequency cables – Telephone cables for non-essential communication services*

IEC 60092-375, *Electrical installations in ships – Part 375: Shipboard telecommunication cables and radio-frequency cables – General instrumentation, control and communication cables*

IEC 60092-376, *Electrical installations in ships – Part 376: Cables for control and instrumentation circuits 150/250 V (300 V)*

IEC 60092-504, *Electrical installations in ships – Part 504: Special features – Control and instrumentation*

IEC 60533:1999, *Electrical and electronic installations in ships – Electromagnetic compatibility*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61196-1, *Coaxial communication cables – Part 1: Generic specification – General, definitions and requirements*