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Measurement method of half-wavelength voltage for Mach-Zehnder optical modulator in wireless communication and broadcasting systems

Méthode de mesure de la tension à une demi-longueur d'onde relative aux modulateurs optiques Mach-Zehnder dans les systèmes de communication et transmission radiofréquence



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CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	7
3 Terms, definitions, symbols and abbreviated terms.....	7
3.1 Terms and definitions.....	7
3.2 Symbols and abbreviated terms	8
4 Electro-optic material based Mach-Zehnder optical modulator	9
4.1 Mach-Zehnder optical modulator	9
4.1.1 Component parts	9
4.1.2 Structure	9
4.2 Requirements for Mach-Zehnder optical modulator	10
4.2.1 General	10
4.2.2 Substrate material	10
4.2.3 Optical waveguide design	10
5 Sampling for quality control	10
5.1 Sampling.....	10
5.2 Sampling frequency	10
6 Measurement method of half wavelength voltage.....	10
6.1 Circuit diagram	10
6.2 Measurement conditions	11
6.2.1 Temperature and environment.....	11
6.2.2 Warming up of measurement equipment.....	11
6.3 Principle of measurement method	12
6.3.1 General	12
6.3.2 Measurement principle	12
6.4 Measurement procedure	14
6.4.1 General	14
6.4.2 Circuit diagram (Type A).....	15
6.4.3 Circuit diagram (Type B).....	16
Annex A (normative) Conventional measurement method of optical modulation index.....	18
A.1 Overview.....	18
A.2 Circuit diagram	18
A.3 Measurement procedure	19
A.3.1 Spectrum analyser method	19
A.3.2 Oscilloscope method	19
Annex B (informative) Calculation method of intermodulation distortions using driving voltage and half-wavelength voltage of Mach-Zehnder optical modulator	20
B.1 Overview.....	20
B.2 Explanation of calculation method.....	20
B.3 Conventional measurement methods of intermodulation distortion	26
B.3.1 General	26
B.3.2 Circuit diagram	26
B.3.3 Precautions to be observed	27
B.3.4 Measurement procedures	27
Annex C (informative) Characteristics of Mach-Zehnder optical modulator.....	29

C.1	Electrical and optical characteristics of Mach-Zehnder optical modulator	29
C.2	Mechanical and environmental characteristics	29
Annex D (informative)	Notes on measurement	31
D.1	Factors of measurement uncertainty	31
D.1.1	Measurement equipment	31
D.1.2	Measurement range	32
D.2	RF power source	33
D.2.1	Limitation from resolution of applied RF power	33
D.2.2	Limitation from the resolution of oscilloscope screen	34
D.3	Examples of measurement results	34
Bibliography	7
Figure 1	– Transfer curve of a Mach-Zehnder optical modulator	8
Figure 2	– Structure of Mach-Zehnder interferometer type optical modulator	9
Figure 3	– Schematic block diagram of the measurement setup	11
Figure 4	– Zero-order Bessel function	13
Figure 5	– Waveform change on the oscilloscope screen	13
Figure 6	– Driving voltage measurement setup	15
Figure 7	– Driving voltage measurement setup using a power divider	16
Figure 8	– Waveforms on the oscilloscope	17
Figure A.1	– Measurement setup referred in IEC 62074-2	18
Figure A.2	– Time variation of photo current	19
Figure B.1	– Mach-Zehnder interferometer type optical modulator	20
Figure B.2	– Quadrature points of a transfer curve for a Mach-Zehnder optical modulator	25
Figure B.3	– Dependency of IM2 on NOMI and bias voltage of a Mach-Zehnder optical modulator	25
Figure B.4	– Relation between IM3 and CMI of a Mach-Zehnder optical modulator	26
Figure B.5	– Conventional intermodulation method	27
Figure B.6	– IMD2 and IMD3	28
Figure D.1	– Errors of half-wave length voltage measurements caused by limitations from the resolution of RF power	33
Figure D.2	– Relative errors of half-wavelength voltage measurement caused by limitations from the resolution of RF power	34
Figure D.3	– Relation between NOMI and IM3 for the Mach-Zehnder modulator (sample #1)	35
Figure D.4	– Relation between NOMI and IM3 for the Mach-Zehnder modulator (sample #2)	36
Figure D.5	– Relation between NOMI and IM2 for the Mach-Zehnder modulator (sample #1)	36
Table 1	– Symbols and abbreviated terms	9
Table C.1	– Characteristics of optical modulator	29
Table C.2	– Mechanical and environmental characteristics	30
Table D.1	– Spectrum analyser uncertainty	31
Table D.2	– Uncertainty budget of power meter at only 2 GHz	32
Table D.3	– Measurement results of half-wave voltages for Mach-Zehnder modulators	35

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MEASUREMENT METHOD OF HALF-WAVELENGTH VOLTAGE FOR MACH-ZEHNDER OPTICAL MODULATOR IN WIRELESS COMMUNICATION AND BROADCASTING SYSTEMS

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The text of this International Standard is based on the following documents:

CDV	Report on voting
103/120/CDV	103/133/RVC

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

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

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INTRODUCTION

A variety of microwave-photonic devices may be used in wireless communication and broadcasting systems. An optical modulator is an interface which converts an electronic signal to an optical signal. In the field of optical fibre communication systems, the first editions of the IEC 62007 series "Semiconductor optoelectronic devices for fibre optic system applications" were published in 1997. In the field of wireless systems, specifications of intermodulation and composite distortion of modulators have been the important issue and have been typically negotiated between users and suppliers. During the International Meeting on Microwave Photonics, a proposal was announced to address standardizations for key devices for radio-over-fibre (RoF) systems.

An RoF system is comprised mainly of two parts; one is the RF to photonic converter (E/O) and the other is the photonic to RF converter (O/E). Radio waves are converted into an optical signal at E/O, and the signal is transferred through the optical fibre, and then the radio waves are regenerated at O/E. The nonlinear distortion characteristics of both E/O and O/E are important for the performance of the system. Semiconductor photodiodes are commonly used for O/E. Several types of optical modulator are used for E/O, such as Mach-Zehnder modulators (MZM), electro-absorption modulators and directly modulated laser diodes (LDs).

This document has been prepared to provide industry standard measurement methods for evaluating electro-optic material based Mach-Zehnder optical modulators to be used in wireless communication and broadcasting systems. The nonlinear distortion characteristics are also important for the performance of the systems. The intermodulation distortion of the MZM is calculated from the driving voltage and the half-wavelength voltage. The details of calculations of the second-order intermodulation distortion (IM2) and the third-order intermodulation distortion (IM3) are described in Annex B. General characteristics of Mach-Zehnder optical modulators in wireless communication and broadcasting systems are described in Annex C. Notes on measurement of the half-wavelength voltage are described in Annex D.

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MEASUREMENT METHOD OF HALF-WAVELENGTH VOLTAGE FOR MACH-ZEHNDER OPTICAL MODULATOR IN WIRELESS COMMUNICATION AND BROADCASTING SYSTEMS

1 Scope

This document specifies a measurement method of half-wavelength voltage applicable to Mach-Zehnder optical modulators in wireless communication and broadcasting systems. In addition, this method is also effective for the estimation of the intermodulation distortion of Mach-Zehnder optical modulators. The method applies for the following:

- frequency range: 10 MHz to 30 GHz;
- wavelength band: 0,8 μm to 2,0 μm ;
- electro-optic material based Mach-Zehnder optical modulators and their modules.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 62007-1, *Semiconductor optoelectronic devices for fibre optic system applications – Part 1: Essential ratings and characteristics*

IEC 62007-2, *Semiconductor optoelectronic devices for fibre optic system applications – Part 2: Measurement methods*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62007-1 and IEC 62007-2 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1 Half-wavelength voltage

Voltage required for a Pockels effect material based Mach-Zehnder optical modulator to induce a phase shift of one-half a wavelength between the lightwaves of two arms of the Mach-Zehnder interferometer

Note 1 to entry: It corresponds to an ON/OFF voltage of the Mach-Zehnder optical modulator as shown in Figure 1