

Sudan University of Science and Technology

College of Postgraduate Studies

**DESIGN OF POWER BUDGET AND RISE TIME
CALCULATOR FOR OPTICAL FIBER LINK**

A thesis submitted in partial fulfillment of the requirements for the degree of M.Sc. in
communication engineering

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الآية

{ وَاصْرِبْ لَهُمْ مَثَلًا أَصْحَابَ الْقَرْيَةِ إِذْ جَاءَهَا
الْمُرْسَلُونَ * إِذْ أَرْسَلْنَا إِلَيْهِمُ اثْنَيْنِ فَكَذَّبُوهُمَا فَعَزَّزْنَا
بِثَالِثٍ فَقَالُوا إِنَّا إِلَيْكُم مُّرْسَلُونَ * قَالُوا مَا أَنْتُمْ إِلَّا
بَشَرٌ مِثْلُنَا وَمَا أَنْزَلَ الرَّحْمَنُ مِنْ شَيْءٍ إِنْ أَنْتُمْ إِلَّا
تَكْذُوبُونَ * قَالُوا رَبُّنَا يَعْلَمُ إِنَّا إِلَيْكُم لَمُرْسَلُونَ * وَمَا
عَلَيْنَا إِلَّا الْبَلَاغُ الْمُبِينُ }

سورة يس 13 - 17

Dedication

To my mother

To my father

To my family

To my friends

To my neighbors

To the teachers in Sinnar university

To the teachers in Sudan university

To the engineers in National Electricity
Corporation

Acknowledgement

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Abstract

The power and rise time budgets are two important approaches in designing fiber optic links. The power budget approach must take into the consideration the power levels across the link. In the rise time approach, the system designer must take into account the temporal response of the system components. In this research a fiber optic link calculator was designed using visual basic 6.0. The calculator was designed to be user friendly and to fulfill all requirements of both approaches. An executable file was made to run the calculator in all computers under all windows operating system that have DLL libraries which comes with the visual basic.

محتويات

ميزانية القدرة والارتفاع الزمني هما طريقتان مهمتان في تصميم ربط الألياف الضوئية . طريقة ميزانية القدرة تأخذ في الاعتبار مستويات القدرة خلال الربط . أما في طريقة الارتفاع الزمني فمصمم النظام لابد أن يأخذ في الحسبان الاستجابة الزمنية لمكونات النظام . في هذا البحث قد صممت الة حاسبة ربط الألياف الضوئية باستخدام لغة البيسك المرئي الاصدار السادس . قد برمجت واجهة صديقة للالة الحاسبة لتلبى متطلبات كل من طريقتى ميزانية القدرة والارتفاع الزمني. وعمل للالة الحاسبة ملف تنفيذي ليتم الاستفادة منها في الحواسيب تحت بئيات نظام التشغيل وندوز المختلفة والتي لابد ان تمتلك مكتبات ال DLL التي تأتي مع البيسك المرئي .

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List of Abbreviations and Symbols

LASER	Light Amplification by the Stimulated Emission of radiation
SNR	Signal to Noise Ratio
SM	Single Mode fiber
MM	MultiMode fiber
SI	Step Index fiber
GRIN	Graded Index fiber
LAN	Local Area Network
FWHP	Full Wave at Half Power
BER	Bit Error Rate
LED	Light Emitting Diode
APD	Avalanche Photodiode
RZ	Return to Zero code format
NRZ	Non Return to Zero
NA	Numerical Aperture
BW.L	The bandwidth-length product for modal dispersion in MHz.Km
τ_{Tx}	Transmitter's rise time
τ_{Rx}	Receiver' rise time
dB	Decibel
dBm	Decibel relative to 1 miliwatt
m	meter
v	velocity
s	second
f	frequency
h	Planck's constant
θ_a	Acceptance Angle
α	index profile parameter
α_{dB}	attenuation of the fiber per unit length
$D(\lambda)$	chromatic dispersion parameter
M_a	safety margin

C_L The connection loss

S_L The splices loss

F_L The fiber loss

P_i The mean input optical power launched into the fiber

P_o is the mean incident optical power required at the receiver

B_T Maximum bit rate in Mbps

B the bandwidth in MHz

L The installation length in Km

λ The operating wave length in nm

$\Delta\lambda$ The spectral width in nm

$D(\lambda)$ The chromatic dispersion parameter in ns/nm.Km

τ_{ele} The rise time of the light wave equipment in ns

The total rise time in ns τ_{sys}

The fiber rise time in ns according to the equipments and bit $\tau_{fiber-B}$ rate or bandwidth

τ_{modal} The rise time in ns caused by modal dispersion

τ_{chrom} The chromatic rise time in ns

$\tau_{fiber-dis}$ The fiber rise time in ns according to the dispersion

GN OF POWER BUDGET