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Evaluation of landline local loops in Egypt

By

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(B.Sc. Electronics and Communications-2004)

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Statement

This dissertation is submitted to Ain Shams University for the degree of Doctor of Philosophy in Electrical Engineering, Electronics and Communications Engineering.

The work that was included in this dissertation was carried out by the author at the Electronics and Communications Engineering Department, Faculty of Engineering, Ain Shams University, Cairo, Egypt.

No part of this dissertation was submitted for a degree or a qualification at any other university or institution.

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In loving memory of my mother, Reda El-Shami

To my wife and family

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Abstract

The landline fixed telephone copper network of Telecom Egypt (TE) company is evaluated. A sample of that network is tested using different available tests. The imperfections of the network is discussed and analyzed to specify the reasons for those imperfections. A new methodology to measure the transmission line parameters and determine the Resistance Fault Location (RFL) using "Three Voltmeter Method" is also introduced. The parameters measurement error percentage is acceptable (< 10%) for resistance, capacitance, characteristic impedance, attenuation constant and phase constant. The inductance and conductance suffer from small accuracy values. The RFL measurement has an error percentage of 6.54% for short cable length and small error value. The methodology used the "Three Voltmeter Method" in addition to Data Acquisition System (DAS).

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$\Im$	Imaginary part of a complex number
N	Number of lines
R	Resistance per unit length of the transmission line
$\Re$	Real part of a complex number
L	Inductance per unit length of the transmission line
L_0	Low frequency inductance
L_∞	High frequency inductance
C	Capacitance per unit length of the transmission line / Speed of light in free space
$\mathbf{C}_\infty$	Contact capacitance
G	Conductance per unit length of the transmission line
V	Voltage / Velocity
V_i	Input voltage
V_o	Output voltage
I	Current
f	Frequency
ω	Angular frequency
Z	Impedance per unit length
Y	Admittance per unit length
γ	Propagation constant
α	Attenuation constant
β	Phase constant
θ	Phase angle
λ	Wavelength
V_p	Phase velocity
V_g	Group velocity
τ_g	Group delay
Z_0	Characteristic impedance
Z_i	Input impedance
Z_L	Load impedance
Z_S	Source impedance
d	Distance
ρ_s	Source reflection coefficient
ρ_L	Load reflection coefficient
E	Electric field
B	Magnetic field
Z_{ioc}	Open circuit transmission line input impedance
Z_{isc}	Short circuit transmission line input impedance
Z_x	Unknown impedance
R_x	Unknown resistance
X_x	Unknown reactance
Z_s	Known impedance

R_s	Known (reference) resistance
X_s	Known (reference) reactance
V_T	Peak voltage across the voltage source
V_x	Peak voltage across the unknown impedance
V_s	Peak voltage across the known impedance
K_r	Individual resistor tolerance
ε_r	Dielectric constant
r_{OC}	Copper DC resistance
r_{OS}	Any steel DC resistance
a_c	Arbitrary constantconstant
a_s	Arbitrary constant
b	Arbitrary constant
C_0	Arbitrary constant
C_e	Arbitrary constant
g_0	Arbitrary constant
g_e	Arbitrary constant
F_x	Ground fault resistance
F_y	Ground fault resistance
T_n	Tip near end terminal
R_n	Ring near end terminal
T_f	Tip far end terminal
R_f	Ring far end terminal