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**The PIN Diode As a Microwave Control
Element**

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requirements of the degree of M.Sc
In
(Electrical Engineering (Power**

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Dedication

**To my parents
To my brothers & sisters
To my colleagues**

ACKNOLEDGEMENT

I would like to express my deep thanks to all who helped me to achieve this project especially to my supervisor

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for the effort, patience and precious experience which had greatly supported and led to the success of this work.

ABSTRACT

Switching and phase shifting are done, in the past with mechanical
. or electromechanical devices

With the advent of ferrite and PN junction semiconductor devices
these operations can be carried out at speeds of at least two or three orders
.of magnitude faster than with electromechanical devices

In the case of ferrites , the control operations are carried out by
changing the magnitude & direction of an externally applied magnetic field
.to the ferrite

In the case of PN junction semiconductor devices , the control is
achieved by varying the bias current or bias voltage across the solid state
.devices

Of the several PN junction devices available , the PIN silicon diode
is the most widely used for two state (digital) microwave control
. operation

The applications of junction diodes to microwave switching and
. phase shifter are numerous and varied

One example is the switching of the power of RF source to several
.antennas or performing duplexing in a radar system

Another application of PIN diode and perhaps the most important
application is the possibility of electronically steering phase array antennas
.using PIN diode phase shifters

في الماضي الفتح والغلق وإزاحة الطور في الأجهزة كانت تقام به أجهزة ميكانيكية أو كهروميكانيكية.

مع عهد أجهزة الخام الحديد (Ferrite) وأشباه الموصلات أصبحت هذه العمليات تجري بسرعة أضعاف سرعة الأجهزة الكهروميكانيكية.

في حالة أجهزة خام الحديد (Ferrite) التحكم في هذه العمليات يجري بتغيير مقدار واتجاه مجال مغناطيسي خارجي يسلط على الخامة الحديدية.

في حالة أجهزة أشباه الموصلات يتم التحكم بتغيير تيار الانحياز أو جهد الانحياز. استخدامات ثنائيات الوصل في الفتح والغلق وإزاحة الطور في حيز الميكرويف متعددة ومتعددة مثل ذلك توزيع القدرة الراديوية لعدة هوائيات وكذا عملية توزيع القدرة بين المرسل والمستقبل في الهوائي في نظم الرادار.

استخدام آخر ربما من أهم الاستخدامات لثنائي PIN هو امكانية قيادة وتوجيه مصفوفات الهوائي الطوريه باستخدام المزاحات الطوريه المستخدمة لثنائي PIN.

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List of Symbols

P	positive region
N	negative region
I	intrinsic region
C_j	junction capacitance
C	case capacitance
L_c	inductance
C_T	total capacitance
R_D	diode resistance
G	junction conduction
R	series resistance
I_F	forward bias current
I_R	reverse bias current
t_d	delay time
t_t	transition time
t_{RR}	reverse recovery time
w	conductor width
t	conductor thickness
h	dielectric thickness
ϵ_r	dielectric constant
ϵ_{eff}	effective dielectric constant

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