

High Quality Signal Switching in the 60 GHz ISM Band

By Dr. Kecheng Xiao

The 60 GHz unlicensed Industrial-Scientific-Medical (ISM) band from 57 to 64 GHz is getting lots of attention, due to its potential to meet the demand of high data-rate wireless com-

The ISM band allows for an unprecedented capacity of information and is ideal for a number of WPAN and WLAN applications. munications. It allows for an unprecedented capacity of information and is ideal for a number of wireless personal area network (WPAN)/wireless local area network (WLAN) applications such as home high-definition multimedia streaming (uncompressed video).

Two short-range wireless technologies, IEEE 802.11ad (WiGig) and WirelessHD, are addressing this band's potential. Other applications include backhaul for wireless base stations, wireless version USB 3.0 rated as high as 5 Gbs/s, and airport body scanners, to list a few. Also interestingly, the traditional shortcoming of high path loss (10–15 dB/km)

due to atmospheric oxygen absorption around 60 GHz leads to this band's other application potential of short-range radar and secure communication within limited area.

Switches, which can be electromechanical or solid-state, always play important roles in RF/Microwave/Millimeter-wave applications. In modern wireless communication, a switch is the key component in transceivers using Time Division Duplex (TDD) system to separate outward and return signals. In a complex system switches are often used to redirect the signal in order to re-use the circuit building blocks and/or pick up different sources or loads.



Electromechanical Switch



Solid-state Switch





CP4-60086030-02

RF and microwave switches are also used extensively in microwave test systems for signal routing between instruments and devices under test (DUT). For all these applications, a quality signal switching is crucial which means low through path insertion loss, high channel isolation, fast switching time, solid reliability and long lifetime. EM switches typically presents less insertion loss and higher isolation than its solid-state counterparts, but switch with much slower speed, less reliability and lifetime. Limited by its mechanical contact switching nature, performing EM switches are hardly obtained above 50 GHz. Solid-state switches which have nanosecond level switching time and compact profile are the preferable choice for the applications in 60 GHz ISM band and above.

To meet the increasing need for switches in 60 GHz ISM band, Ducommun recently developed several PIN diode based switches in the V band range of 50 - 75 GHz. These switches cover a variety of user interfaces, wide/ narrow frequency range options, as well as multi-throw numbers to take care of various application requirements.

56 - 64 GHz SP4T PIN Diode Switch with WR-15 Interface

Model CP4-60086030-02 is a V-band single pole four throw reflective PIN diode switch fabricated in GaAs monolithic technology and incorporating a TTL compatible driver. The switch has WR-15 waveguide with



Switch control logic and outline

SPECIFICATIONS	of CP4-60086030-02
Frequency:	56 to 64 GHz
Insertion Loss:	5.0 dB (Typ), 6.0 dB (Max)
Isolation:	30 dB (Min)
I/O VSWR:	2 : 1 (Typ)
Control:	2-bit TTL
DC Bias:	+ 5 V@20 mA (Typ)
	- 5 V@1 mA (Max)
I/O Connectors:	WR-15 Waveguide w/
	UG-385/U-M Flanges
Switching Speed:	200 nS (Max)
RF Power Handling:	+23 dBm CW
Temperature Range:	-55 to +85 °C
Weight	2 oz



UG-385/U-M flange as I/O interface and its primary function is to switch signals in the frequency range 56 to 64 GHz from one waveguide channel to others. The switch is operated by a pair of +/- 5 V DC bias and is activated by a 2-bit TTL signal, both applied through the Molex/10-pin control connector.

This SP4T switch is realized by connecting three SPDT PIN devices as illustrated with RF and switch driver circuitries separated in their own cavities, to enhance the excellent channel isolation. The $1.7" \ge 1.4"$

x 1.02" compact package is goldplated and weighs 2 oz. The unit exhibits excellent insertion loss of typically smaller than 5dB, isolation of greater than 30 dB, as well as switching speed of faster than 100 ns within the range of 56-64 GHz.

The switch's specifications and performance are summarized in the table and chart on the left.

Though not shown in the above performance chart, this switch is able to perform well beyond the specified range of 56 - 64 GHz. Also noteworthy is that via Ducommun's proprietary filtering technology the switch's video transient can be suppressed to the level of as low as 20 mVp-p. Other port options such as SPST, SPDT, SP6T and SP8T of this 56-64 GHz switches with WR-15 waveguide interface are also available for specifying.

58 - 64 GHz SP4T PIN Diode Coaxial Switch

Besides the 60 GHz PIN diode switches with WR-15 waveguide interface, Ducommun also offers single-pole multi-throw switches in coaxial form with 1.85 mm connectors to meet diversified application needs in V band. SPST, SPDT and SP4T switches are currently available. Shown is the SP4T model CP4-62804020-D2, which has the technical characteristic listed in the table on top of page 40.

The SP4T switch is in a compact $1.7" \ge 1.4" \ge 1.02"$ gold-plated package, and its excellent isolation, low insertion loss and fast switching features make it a per-

fect switch of choice for RF engineers.

WR-15 PIN Diode Switches Covering Full V-Band

CPS-63253025-01 and CPD-63254025-01 are Ducommun's other two models of PIN switches which are SPST and SPDT, respectively, covering the full V band of 50 -75 GHz with extremely flat insertion loss and isolation performances. Employing inline and discrete PIN diode/Schottky diode technologies, these two models exhibit particularly low insertion loss which can





CP4-62804020-D2

be desired in many specific applications where loss induced degradation on receiving noise figure and/or transmitting power are sensitive and critical.

Besides the above PIN diode switches for 60 GHz ISM band, Ducommun has a full line of electromechanical switch family (DC-46 GHz) and solid state PIN diode switch family (30 MHz-110 GHz) to supply the booming RF/Microwave/Millimeter-wave industry. Additional information about Ducommun's EM and SS switch products can be obtained via email at Rfsales@ ducommun.com.

SPECIFICATIONS	of CP4-62804020-D2
Frequency:	58 to 64 GHz
Insertion Loss:	6.0 dB (Typ), 8.0 dB (Max)
Isolation:	20 dB (Min)
I/O VSWR:	2 : 1 (Typ)
Control:	2-bit TTL
DC Bias:	+ 5 V@20 mA (Typ)
	- 5 V@1 mA (Max)
I/O Connectors:	1.85 mm (F)
Switching Speed:	200 nS (Max)
RF Power Handling:	+23 dBm CW
Temperature Range:	-55 to +85 °C
Weight	2.4 oz

About the Author

Dr. Kecheng Xiao is the engineering manager of RF product at Ducommun Inc. He received his PhD in astrophysics from Nagoya University, Japan and his BSEE & MSEE degrees in microwave/millimeter-wave technology from Southeast University, China. He has worked more than 30 years in mW/mmW area across academia and industry. His current interests include mmW component and subsystem development, low noise technology, sensor&radar, and wireless communications. He has been with Ducommun for 11 years.



Full V band PIN diode Switches

