Novel Compact CPW Filtenna Structures

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Abstract - In this paper, two compact coplanar monopole filter_antenna structures have been proposed and presented. A detailed parametric study has been carried out using a commercial software package (CST_MW Studio) to investigate the effects of reconfigurable both patch and ground structure (**RP** & **RGS**) on the filtration and radiation characteristics of the proposed filtennas. The proposed reconfigurable patch (RP) resonators are **H_Slot** patch shape and **Edge_Slot** patch shape, where the overall patch dimensions are assumed constant. The proposed reconfigurable ground structure (RGS) includes Extended Open Circuit ground "**EOC**", Extended Short Circuit ground "**ESC**", Symmetric Truncated Open Circuit ground "**STOC**", and Asymmetric Truncated Open Circuit ground "**ATOC**". The first proposed CPW filtenna is referred to as coplanar **H_S**lot **P**atch **F**iltenna with a reconfigurable ground structure "**CPW_HSPF_RGS**", while the second filtenna is referred to as coplanar **E**dge_**S**lot **P**atch **F**iltenna with a reconfigurable ground structure "**CPW_ESPF_RGS**". These filtennas are simulated and fabricated using a lossy and compact FR-4 substrate. Simulation results indicate that the filtration and radiation characteristics of the proposed filtennas are highly dependent on the selected RGS pattern as well as the patch resonator shape. In other word, unlike the conventional CPW monopole (UWB antenna), they resonate at multi-frequencies having different isolated operating bands. Also, these filtennas cover many wireless applications including the 3G and 4G bands. Therefore, filtration and radiation characteristics of the proposed filtennas can be adjusted using the proposed RGS pattern and the patch resonator shape. The presented filtenna structures are very compact in size and they are easy to fabricate. Good agreement has been obtained between simulated and measured CPW Filtenna characteristics over a wide frequency band (up to 15.0 GHz).

Keywords – Filter-Antenna Structure, CPW Filtenna, H-slot patch filtenna, Edge-slot patch filtenna

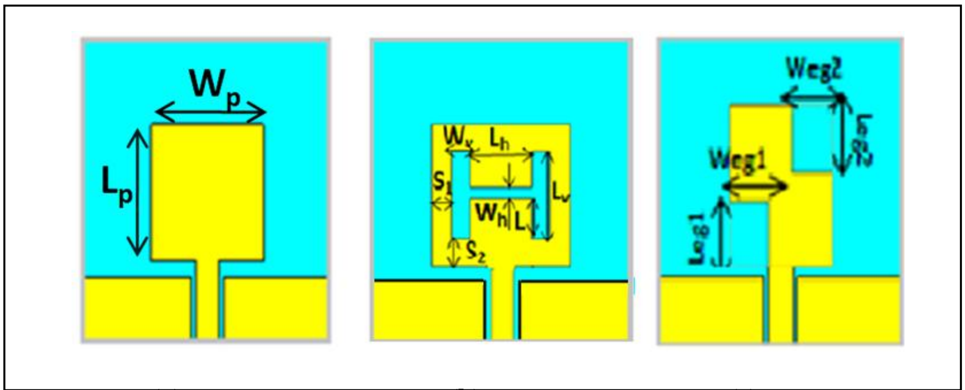
1 INTRODUCTION

In recent years, planar filter-antenna modules have been received a great attention due to their low fabrication cost, compact size, and function duality, and they are referred to as planar filtenna chips. Planar filtennas includes microstrip, coplanar, and stripline chips embedded on the motherboard and they are either fed by transmission line or coaxial connector based on the nature circuit. Indeed, the use of planar filtenna chips in wireless communication system eliminates the necessity of using band pass filter module. Over the past few years, there are many filter-antenna structures have been proposed, investigated and reported. A CPW-fed planar UWB monopole filter-antenna consists of tapered and modified ground plane structure has been proposed (Dau-Chyrh Chang et al., 2006) for wireless applications. An UWB coplanar boat microstrip patch filter-antenna was reported by (Dalia Nashaat et al., 2009). The filtration was carried out by modifying ground plane using Electromagnetic Band Gap Structure (EBG/defective ground structure). A novel miniature Strip-Line fed antenna having band-notched filter was proposed (S. Tu et al., 2009). There are different shapes of the CPW monopole patch resonators were proposed such as CPW-fed octagon shape slot antenna (S. Natarajamani1et al., 2009) to achieve a broadband characteristic useful for UWB applications. Also, other filter-antenna structures were reported such as a disk-loaded monopole array antenna with coplanar waveguide having active devices (PIN diodes) (M. R. Kamarudin et al., 2010) and U-shaped coplanar feed-line patch (MEMs) (H. H. Wang et al., 2011). A new compact narrowband, broadband and ultra-wideband microstrip patch filtenna structures (dual/triple/forth) operating in 3G and 4G applications was proposed and reported (Ghouz H. H. M, Oct., 2012). The filtration was achieved using partitioned ground structure (Digital ground structure) and short circuit vies located at the patch edges. In addition, other published work including band notch filters of an UWB monopole was proposed and reported. The monopole was a microstrip patch antenna having single and/or double band-notch filters to achieve a band rejection for WLAN, WiMax, WiFi and LTE applications (Anvesh Rajput et al., 2012 and Ghouz H. H. M et al., 2013). Also, a microstrip filtenna structures having multi resonances frequencies and distinct band rejection filters were investigated and reported (Reham Hamdy & Ghouz H. H. M, 2013, and 2014). In this work, the filtration was carried out through ground structure and patch shape reconfigurations.

In this paper, two novel coplanar filter_antenna structures have been proposed and presented. No active elements were used to control the filtration and radiation characteristic of the proposed CPW filtennas. Instead, reconfiguration of both patch shape (RP) and ground plane structure (RGS) has been proposed. The proposed CPW filtennas are coplanar **H_S**lot **P**atch **F**iltenna and coplanar **E**dge_**S**lot **P**atch **F**iltenna with reconfigurable ground structures. They are referred to as **CPW_HSPF_RGS** and **CPW_ESPF_RGS** respectively. Ground and patch reconfiguration create passband and rejection band to control the filtration and radiation characteristics of the CPW_Filtennas. The presented paper is organized among four main sections. A Detailed geometry description of the proposed CPW H_Slot patch filtenna and CPW Edge_Slot patch filtenna are presented in section (2). Simulation results of the proposed filtenna structures are presented and discussed in details in section (3). Section (4), presents the fabricated filtenna configurations and their dimensions. The measured and simulated S-parameters of these filtennas are also presented, discussed and compared in this section. Finally, the presented paper is concluded in section (5).

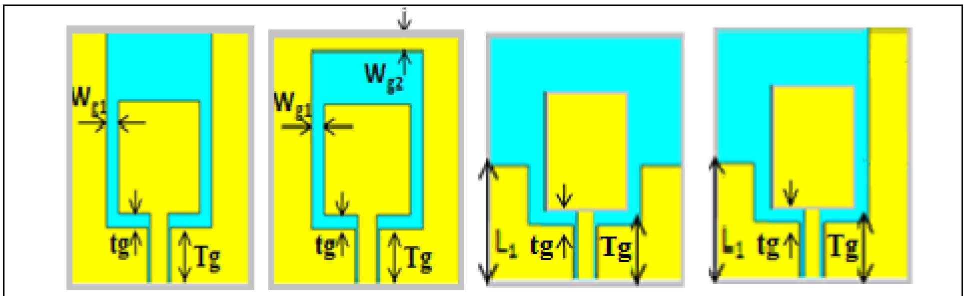
2 DESCRIPTION OF THE PROPOSED FILTENNA CONFIGURATIONS

Two compact CPW monopole filtenna structures have been proposed and presented. This includes reconfiguration of both CPW ground structure (RGS) and the patch resonator shape (RP). A coplanar monopole antenna having a square patch resonator is assumed and referred to as conventional monopole (CMP) antenna as shown in Fig.1 (a). This CMP has been used as an UWB reference antenna for the proposed CPW filtenna structures. The **first type of proposed coplanar monopole filtennas** has a conventional ground with reconfigurable patch shape (defective patch slots) where, the overall patch dimensions are kept constant as shown in Fig.1 (b) and Fig.1 (c). As it is clear from these figures, two slot shapes are assumed. The first slot type is an H_Slot shape and it consists of three slots, two vertical slots and one horizontal slot. The dimensions of these slots are listed in Table 1. The second slot type is an Edge_Slot shape and it consists of two edge slots, lower left edge slot and upper right edge slot. This includes symmetric edge slot "SES" and asymmetric edge slot "AES". Dimensions of the assumed edge slots are listed in Table 2. The proposed filtennas having reconfigurable patch shape (first type) are referred to as coplanar H_Slot Patch Filtenna "**CPW_HSPF**" and coplanar Edge_Slot Patch Filtenna "**CPW_ESPF**". Also, coplanar filtenna with symmetric edge slot patch is referred to as CPW_SESPF, while coplanar filtenna with asymmetric edge slot patch is referred to as CPW_AESPF. The **second type of proposed filtennas** has a reconfigurable ground structure (RGS) with the same square patch resonator as shown in Fig.2 (a) through Fig.2 (d). The different reconfigurable ground structure "RGS" includes extended open circuit ground "EOC", extended short circuit ground "ESC", symmetric truncated open circuit ground "STOC", and asymmetric truncated open circuit ground "ATOC". Dimensions of the different "RGS" are listed in Table 3. H_slot patch and Edge_slot patch resonators are also included for the second type of the proposed filtennas. In other word, for example, the proposed CPW_HSPF having an EOC ground is referred to as CPW_HSPF_EOC, while the CPW_SESPF having EOC is referred to as CPW_SESPF_EOC. This is the same for the other proposed RGS patterns. The proposed monopole filtennas have been mounted on a compact and single FR-4 substrate (ε_r=4.7, and 1.6 mm height with tangential loss of 0.025) with conductor thickness of 0.035mm. The dimensions of the substrate are L_{Sub}=30.0 mm and W_{Sub}=30.0 mm, while the basic patch dimensions are L_P=13.50 mm and W_P=13.50 mm. A transmission line of 50.0 Ohm is used to feed the patch with length and width are L_F=8.25 mm and W_F=2.86 mm respectively.



(a) (b) (c)

Fig. 1 Top view of CPW monopole antenna: (a) conventional CPW monopole antenna (CMP), (b) proposed CPW H_Slot patch filtenna (CPW_HSPF) (c) proposed CPW Edge_Slot patch filtenna (CPW_ESPF)



(a) (b) (c) (d)

Fig.2 CPW with reconfigurable ground structure (RGS): (a) Extended open circuit (EOC), (b) Extended short circuit (ESC), (c)Symmetric truncated open circuit (STOC), and (d) Asymmetric truncated open circuit (ATOC)

Table 1 H_Slot dimensions and locations

Symbol	Value (in mm)	Symbol	Value (in mm)
W_v	1.8	L	4.0
L_v	8.5	S_1	2.0
W_h	1.0	S_2	2.5
L_h	5.9	-	-

Table 2 Edge Slots dimensions and locations

Symbol	Value (in mm)	Symbol	Value (in mm)
Weg1= Weg2 (SES)	3.32	Leg1= Leg2 (SES)	2
Weg1 (AES)	2.32	Leg1 (AES)	4
Weg2 (AES)	3.32	Leg2 (AES)	2

Table 3 Dimensions and locations for the different RGS

Symbol	Value (in mm)	Symbol	Value (in mm)
T_g (CMP)	6.75	t_g (CMP)	1.5
W_{g1} (EOC)	2	W_{g2} (ESC)	1.75
L_1 (STOC)	14	-	-

3 SIMULATION RESULTS AND DISSCIONS

Performance of the proposed CPW monopole filtennas (CPW_Filtennas proposed in pervious section) has been evaluated, investigated and compared to the conventional monopole antenna (CMP). Two main CPW filtennas have been proposed for four different reconfigurable ground structure (RGS). These are coplanar H_Slot patch filtenna “CPW_HSPF” and coplanar Edge_Slot patch filtenna “CPW_ESPF. The ground configuration includes Extended open circuits ground “EOC”, Extended short circuits ground “ESC”, Symmetric truncated open circuits ground “STOC”, and Asymmetric truncated open circuits ground “ATOC”. First, the proposed CPW_HSPF structure have a rejection band from 4.0 GHz to 5.0 GHz (WiMax band), and it is compared to CMP antenna as presented in Fig.2. In addition, it has three resonances frequencies at 3.5, 6.2 & 9.5 GHz. On the other hand, the proposed CPW_ESPF structure has an UWB radiation as presented in Fig.3. The edge slot has the effect of increasing the antenna bandwidth by a factor of 100% in case of asymmetric edge slot (AES). However, symmetric edge slot increased the band by factor of 40% only. Indeed, the patch slots (H_slot and Edge_slot) altered the current distribution on the patch surface which created stopbands and passbands within the UWB of the conventional monopole antenna (CMP). This current is computed and presented in Table 4 for some selected resonance frequencies. Gain, efficiency, and bandwidth at these resonances are also listed in Table 4 for the S-parameters presented in Fig.2 and Fig.3.

Second, the effect of EOC ground configuration on the proposed CPW filtennas has been evaluated and presented in Fig.4 and Fig.5. This includes CMP_EOC, CPW_HSPF_EOC, CPW_AESPF_EOC and CPW_SESPF_EOC respectively. It is clear that, the EOC act as built in bank of band rejection filters controlling the radiation and filtration characteristics of the proposed CPW filtennas. Table 5, illustrates gain, efficiency and bandwidth of these filtennas at some selected resonance frequencies. The current distribution is also presented this table.

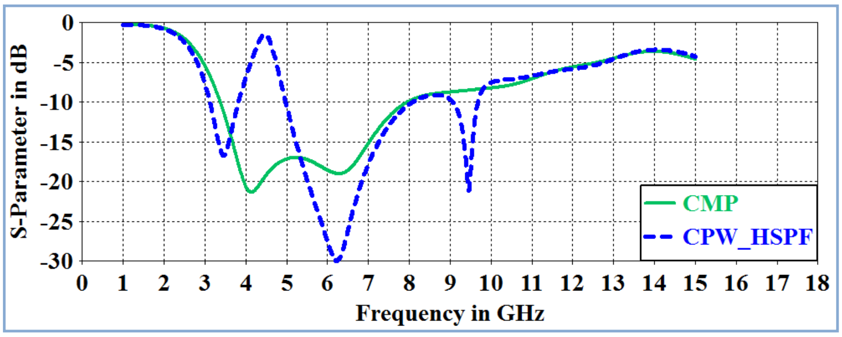


Fig. 2 S11| of CPW_HSPF versus CMP

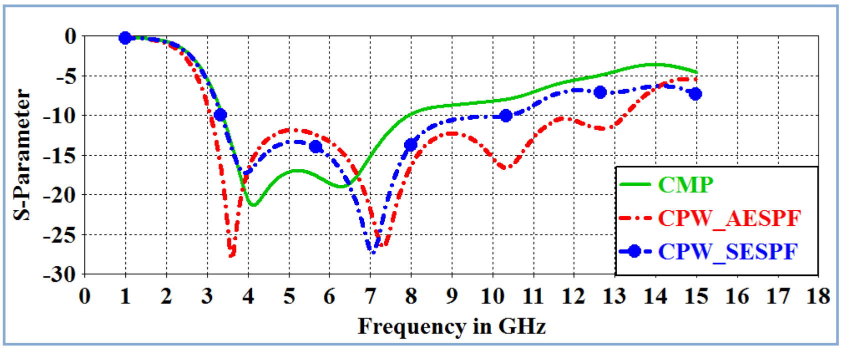
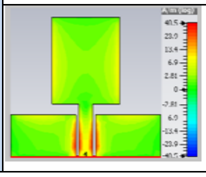
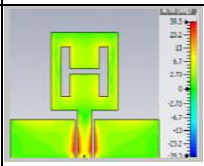
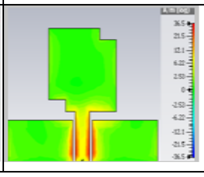
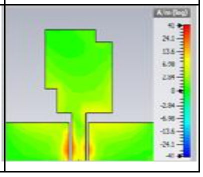


Fig. 3 S11| of CPW_SESPF and CPW_AESPF versus CMP

Table 4 Parametrs of CMP, CPW_HSPF and CPW_ESPF

	CMP (Ref.)	CPW_HSPF	CPW_SESPF	CPW_AESPF
Surface current density	F= 6.4 GHz Eeff = 44% Gain= 3.68 dB BW=4800 MHz	F=6.2GHz Eeff =45% Gain=3.5dB BW=3110MHz	F=7.0 GHz Eeff =85% Gain= 3.9dB BW= 6000MHz	F=7.3GHz Eeff =82% Gain=4.5dB BW= 2000MHz
				

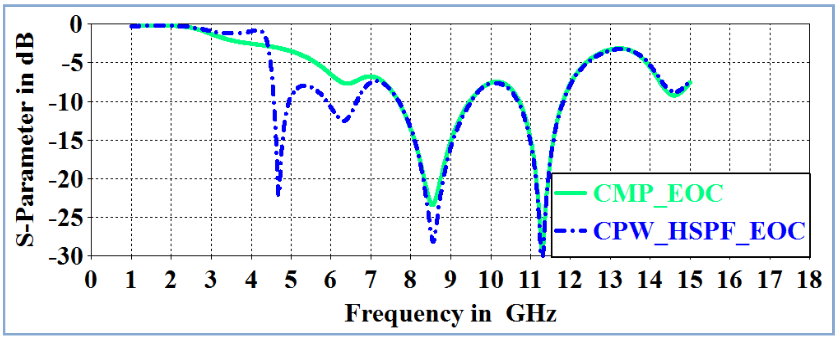


Fig.4 S11| of CPW_HSPF_EOC versus CMP_EOC

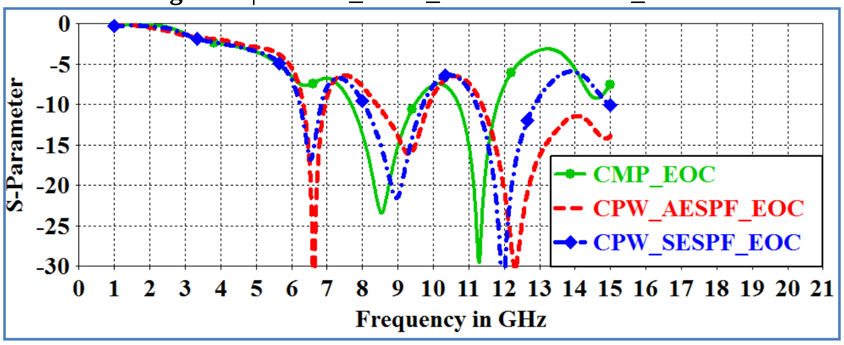
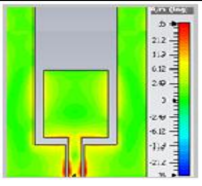
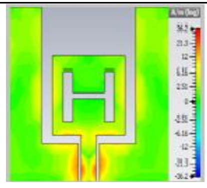
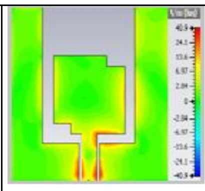
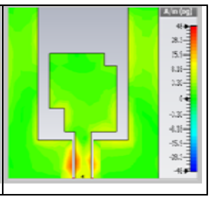


Fig.5 S11| of CPW_SESPF_EOC & CPW_AESPF_EOC versus CMP_EOC

Table 5 Parameters of CMP_EOC, CPW_HSPF_EOC, CPW_AESPF_EOC and CPW_SESPF_EOC

	CMP (Ref.)	CPW_HSPF	CPW_SESPF	CPW_AESPF
	F= 8.5 GHz Eeff =72% Gain=4.1 dB BW= 4100MHz	F=8.5GHz Eeff =64% Gain=3.1 dB BW=1500MHz	F=8.9GHz Eeff =35% Gain= 5.07dB BW= 1500MHz	F=6.6GHz Eeff =73% Gain=3.5dB BW= 800MHz

Surface current density in case of EOC ground				

Third, the effect of ESC ground configuration on the proposed CPW filtennas has been evaluated and presented in Fig.6 and Fig.7. This includes CMP_ESC, CPW_HSPF_ESC, CPW_AESPF_ESC and CPW_SESPF_ESC respectively. It is clear that, the ESC act as built in dual band pass filter controlling the radiation and filtration characteristics of the proposed CPW filtennas (4.8-5.8 & 9.5-11.5 for HSPF_ESC, 5.1-5.8 & 10-11.5 for CMP_ESC, 7.4-8.7 & 11-15 for AESPF_ESC and 7.4-8.1 & 10.5-12.5 for SESPF_ESC). Table 6, illustrates gain, efficiency, bandwidth and the current distribution of these filtennas at some selected resonance frequencies.

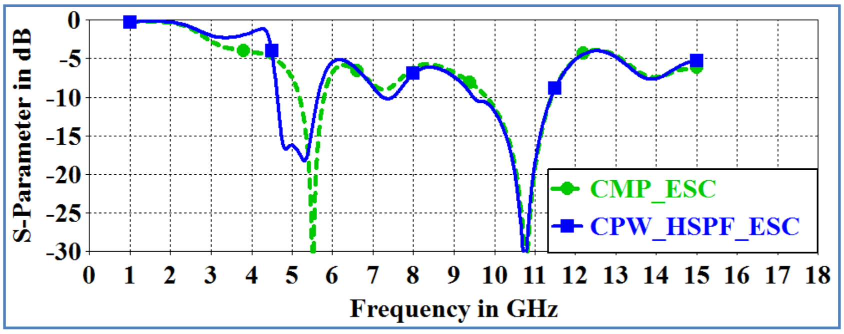


Fig. 6 S11| of CPW_HSPF_ESC versus CMP_ESC

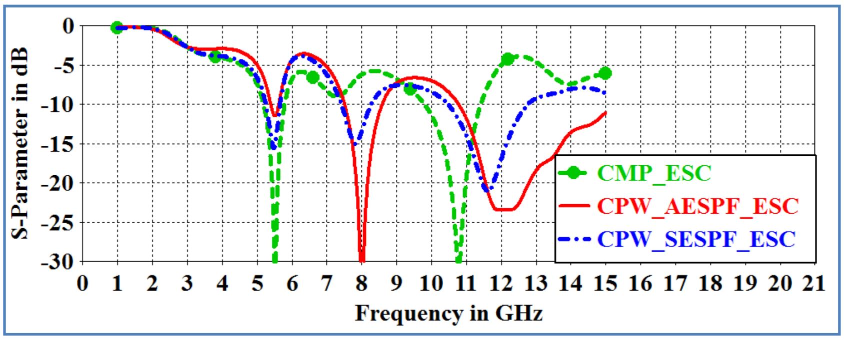
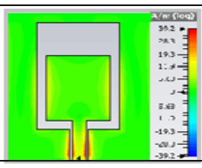
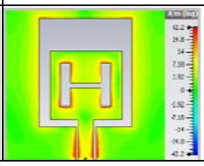
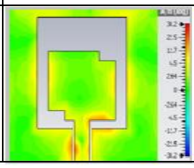
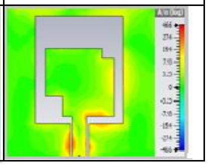


Fig. 7 S11| of CPW_SESPF_ESC & CPW_AESPF_ESC versus CMP_ESC

Table 6 Parameters of CMP_ESC, CPW_HSPF_ESC, CPW_AESPF_ESC and CPW_SESPF_ESC

	CMP (Ref.)	CPW_HSPF	CPW_SESPF	CPW_AESPF
Surface current density in case of ESC ground	F=5.5 GHz Eeff =29% Gain=1.77dB BW= 670MHz	F=5GHz Eeff =75% Gain=2.06dB BW=1000MHz	F= 7.8GHz Eeff =66% Gain=2.9dB BW= 800MHz	F= 8GHz Eeff =59% Gain=3.06dB BW=1100MHz
				

Fourth, the effect of STOC ground configuration on the proposed CPW filtennas has been evaluated and presented in Fig.8 and Fig.9. This includes CMP_STOC, CPW_HSPF_STOC, CPW_AESPF_STOC and CPW_SESPF_ STOC respectively. It is clear that, the STOC act as built in single bandpass filter controlling the radiation and filtration characteristics of the proposed CPW filtennas. Also, the edge_slot (symmetric and asymmetric) has the effect of controlling the CPW passband as compared to CMP with STOC ground (7.5-13, 9.7-14.5, & 7-11 respectively). Table 7, illustrates gain, efficiency and bandwidth of these filtennas at some selected resonance frequencies. The current distribution is also presented this table.

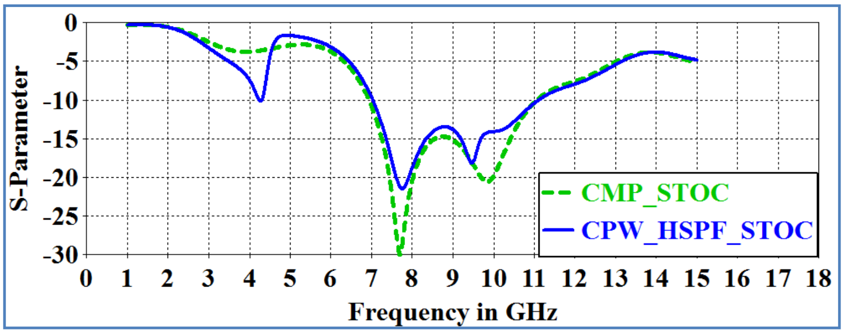


Fig. 8 S11| of CPW_HSPF_STOC versus CMP_STOC

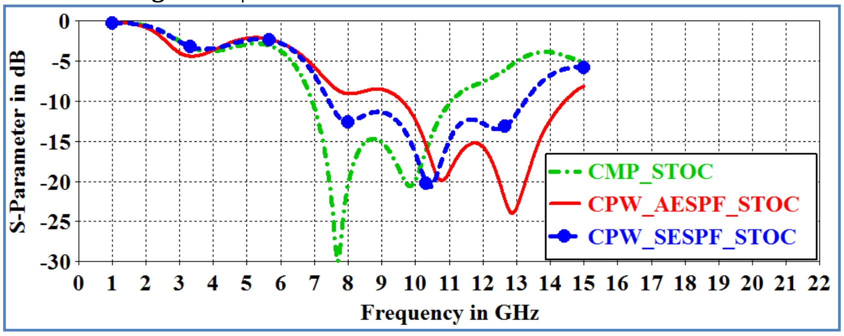
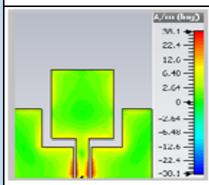
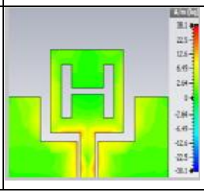
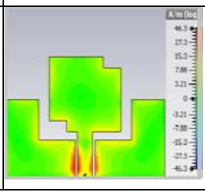
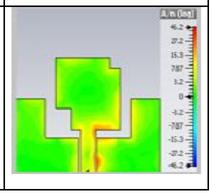


Fig.9 S11| of CPW_AESPF_STOC & CPW_SESPF_STOC versus CMP_STOC

Table 7 Parameters of CMP_STOC, CPW_HSPF_STOC, CPW_AESPF_STOC and CPW_SESPF_STOC

	CMP (Ref.)	CPW_HSPF	CPW_SESPF	CPW_AESPF
Surface current density in case of STOC ground	F=7.8GHz Eeff =77% Gain=3.06 dB BW= 4100MHz	F=9.4 GHz Eeff =66% Gain=4.64dB BW=1100 MHz	F=8.0 GHz Eeff =46% Gain=5.72dB BW= 5800MHz	F=10.7GHz Eeff =59% Gain=5.11dB BW=2000MHz
				

Finally, the effect of ATOC ground configuration on the proposed CPW filtennas has been evaluated and presented in Fig.10 and Fig.11. This includes CMP_ ATOC, CPW_HSPF_ ATOC, CPW_AESPF_ ATOC and CPW_SESPF_ ATOC respectively. It is clear that, the ATOC ground act as built in single UWB bandpass filter controlling the radiation and filtration characteristics of the proposed CPW filtennas (HSPF_ATOC, SESPF_ATOC, AESPF_ATOC and CMP_ATOC). Table 8, illustrates gain, efficiency, bandwidth and the current distribution of these filtennas at some selected resonance frequencies from Fig.10 and Fig.11.

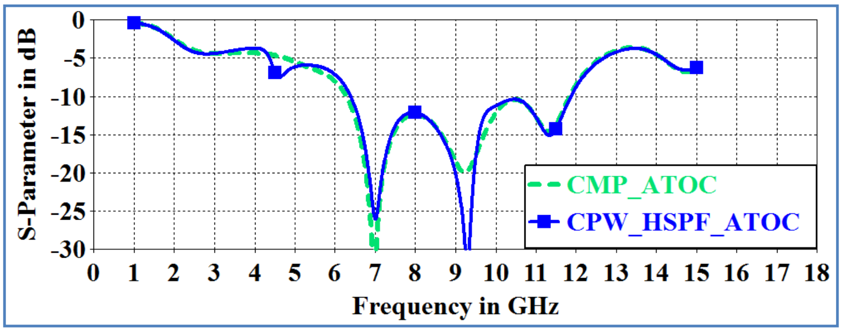


Fig. 10 S11| of CPW_HSPF_ATOC versus CMP_ATOC

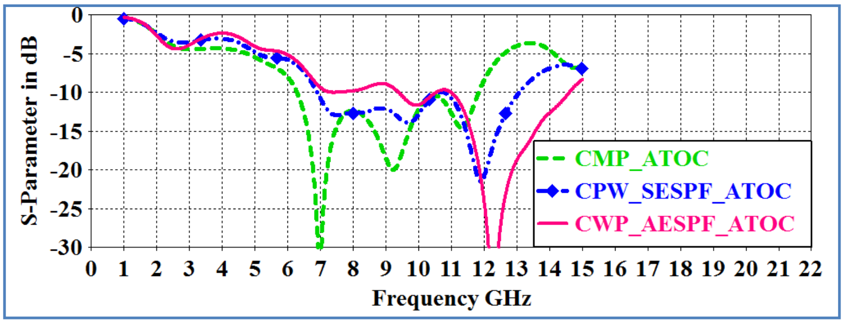
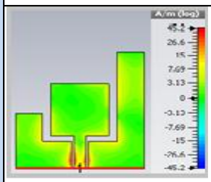
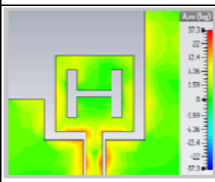
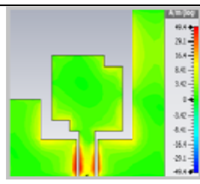
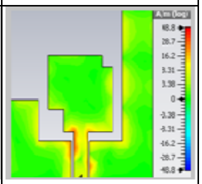


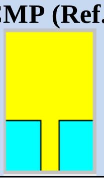
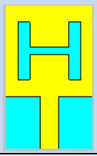
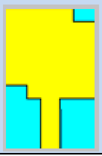
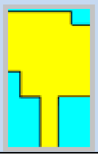
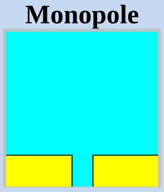
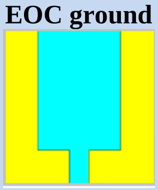
Fig. 11 S11| of CPW_SESPF_ATOC & CPW_AESPF_ATOC versus CMP_ATOC

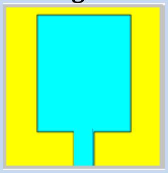
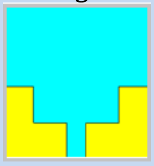
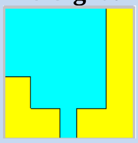
Table 8 Parameters of CMP_ATOC, CPW_HSPF_ATOC, CPW_SESPF_ATOC & CPW_AESPF_ATOC

	CMP (Ref.)	**CPW_HSPF**	**CPW_SESPF**	**CPW_AESPF**
Surface current density in case of ATOC ground	F= 6.9GHz Eeff =48% Gain=5.56dB BW= 5600MHz	F=9.3 GHz Eeff =66% Gain=5.5 dB BW= 1500MHz	F=7.3 GHz Eeff =45% Gain=6.4 dB BW= 3700MHz	F= 12.3GHz Eeff =56% Gain=4.5dB BW= 4500MHz
				

In summary, Table 9 presents a comparison between H_Slot patch and Edge_Slot patch Filtennas for different four RGS patterns. A conventional monopole (CMP) patch is also used as reference antenna in the presented table. All values of the resonance frequencies presented in the table are in gigahertz.

Table 9 Performance summary of proposed CPW_Filtennas

	CMP (Ref.) 	**HSPF** 	**SESPF** 	**AESPF** 
Monopole 	UWB 3.2-8 GHz	Three resonances 3.5, 6.2&9.5 Passbands 3 – 3.9, 5-8 & 9–9.8 Stopbands 1 – 3, 3.9-5 8-9, & 9.8 -15	UWB 3.2-9.3GHz	UWB 3.06-13.2
EOC ground 	Two resonances 8.5 & 11.3 Passbands 7.8– 9.5 & 10.9 – 11.8	Three resonances 4.8, 8.6&11.3 Passbands 4.5 – 5, 7.8-9.5 & 10.8–11.8 Stopbands 1 – 4.5, 5-7.8 9.5-10.8, & 11.8 -15	Three resonances 6.7, 8.9&12 Passbands 6.2 – 7,8-9.8 & 11.2–13 Stopbands 1 – 6.2, 7-8 9.8-11.2, & 13 -15	Three resonances 6.5, 9.3, & 12.3 Passbands 6.2-7, 8.4-9.8 & 11.3-15 Stopbands 7-8.4 & 9.8-11.3

ESC ground 	Two resonances 5.5 & 10.9 Passbands 6.1– 5.9 & 9.9 – 11.3	Two resonances 5 &10.9 Passbands 4.8– 5.8 & 9.9–11.3 Stopbands 1 – 4.8, 5.8-9.9 & 11.3-15	Three resonances 5.5, 7.8 &11.8 Passbands 5.2 – 5.7,7.5-8.3& 10.7–12.5 Stopbands 1 – 5.2, 5.7-7.5 8.3-10.7, &12.5 - 15	Two resonances 8 &11.2 Passbands 7.5-8.5 & 10.8-15 Stopbands 1-7.5 & 8.5-10.8
STOC ground 	Two resonances 7.6 & 9.8 Passbands 6.9 -11.1 BW=4000 MHz	Two resonances 7.73 & 9.45 Passbands 7.1-11.2 BW=4000 MHz Stopbands 1 – 7.1 & 11.2-15	UWB 7.40-13.2GHz	UWB 9.6-14.5
ATOC ground 	Three resonances 6.9, 9.2, &11.3 Passbands 6.2 -11.9 BW=5000 MHz	Three resonances 7.1, 9.3&11.3 Passbands 6.37-11.90 BW=5500 MHz Stopbands 1 – 7.1 & 11.3-15	UWB 6.9 – 13.0 GHz	Wide Band 11-14.5 GHz

4 FABRICATIONS AND MEASUREMENTS

Four filtenna structures have been selected to fabricate prototypes for testing and measurement. These are CMP_EOC, CPW_HSPF_EOC, CPW_SESPF_EOC, and CPW_AESPF_EOC as presented in Fig.14 respectively. The S-parameters have been measured using VNA_HP 8510C network analyzer (45 MHz - 40 GHz). Dimensions of the fabricated filtenna structures are listed in Table 10. Measured and simulated S-parameters are compared and represented in Fig.13 through Fig.16. It is clear that discrepancies between measured and simulated data have been obtained. In fact, this is due to effect of the SMA connectors, the soldiering points and the filtenna orientation during the test. However, measured and simulated s-parameters are in good agreement. In addition, the measured results verified the design methodology of how the antenna filtration characteristic can be adjusted using the concept of reconfigurable both patch shape and ground structure.

Table 10 The dimensions of the fabricated filtenna structures (CMP_EOC, CPW_HSPF_EOC, CPW_SESPF_EOC and CPW_AESPF_EOC)

Symbol	Value (in mm)	Symbol	Value (in mm)
W_{sub}	30	L_{sub}	30
W_p	13.5	L_p	13.5
W_F	2.86	L_F	8.25
W_v	1.8	W_h	1.0
L_v	8.5	L_h	5.9
S_1	2.0	S_2	2.5
L	4.0	h_{sub}	1.6
Tg	1.5	Wg1	2
W_{sub}	30	L_{sub}	30
W_p	13.5	L_p	13.5
W_F	2.86	L_F	8.25
W_v	1.8	W_h	1.0

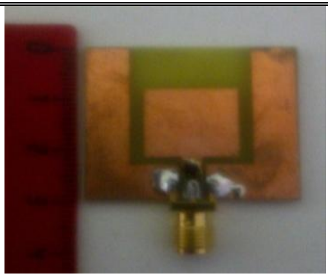
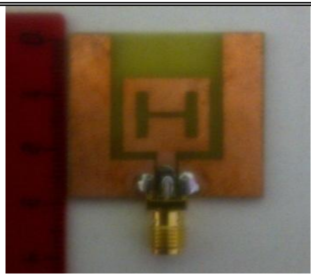
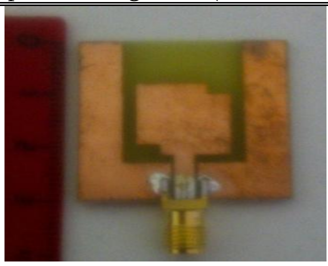
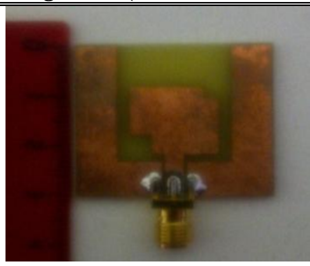
 Conventional monopole with extended Open circuit ground (**CMP_EOC**)	 H-slot patch_ with extended Open circuit ground **(CPW_HSPF_EOC)**
 Symmetric Edge _Slot patch with extended Open circuit ground (**CPW _SESPF_EOC**)	 Asymmetric Edge _Slot patch with extended Open circuit ground (**CPW _AESPF_EOC**)

Fig. 12 Fabricated filtennas (CPW_HSPF, CPW_SESPF and CPW_AESPF)

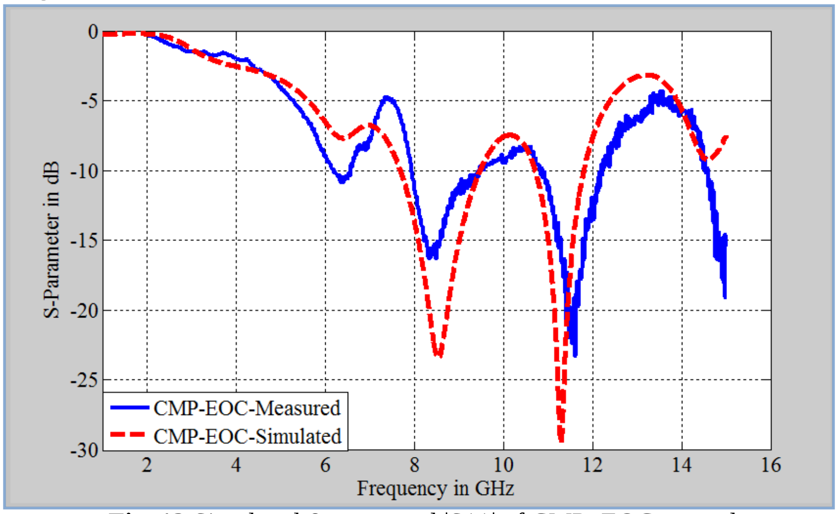


Fig. 13 Simulated & measured |S11| of CMP_EOC ground

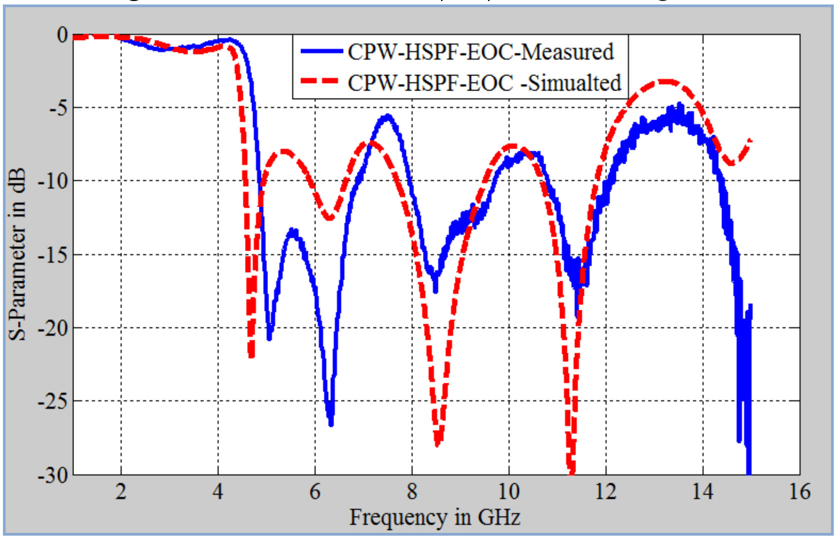


Fig. 14 Simulated & measured |S11| of CPW_HSPF_EOC

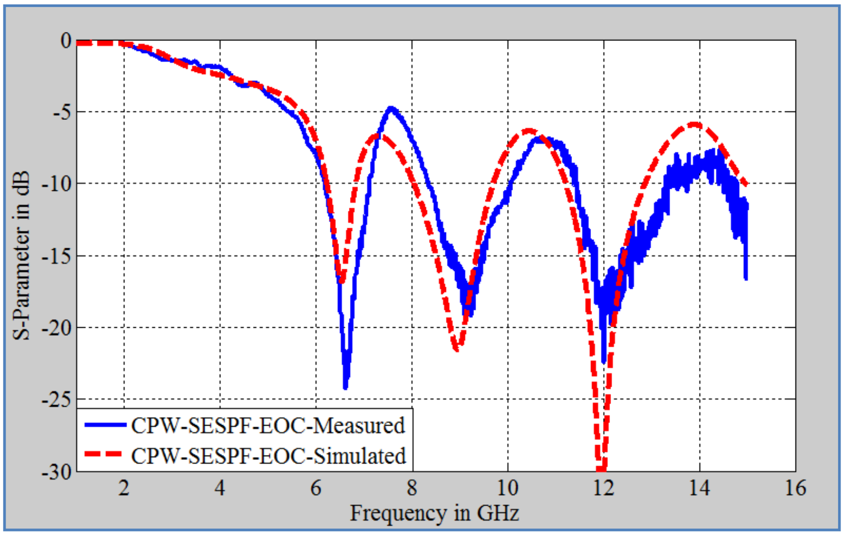


Fig. 15 Simulated & measured |S11| of CPW_SESPF_EOC

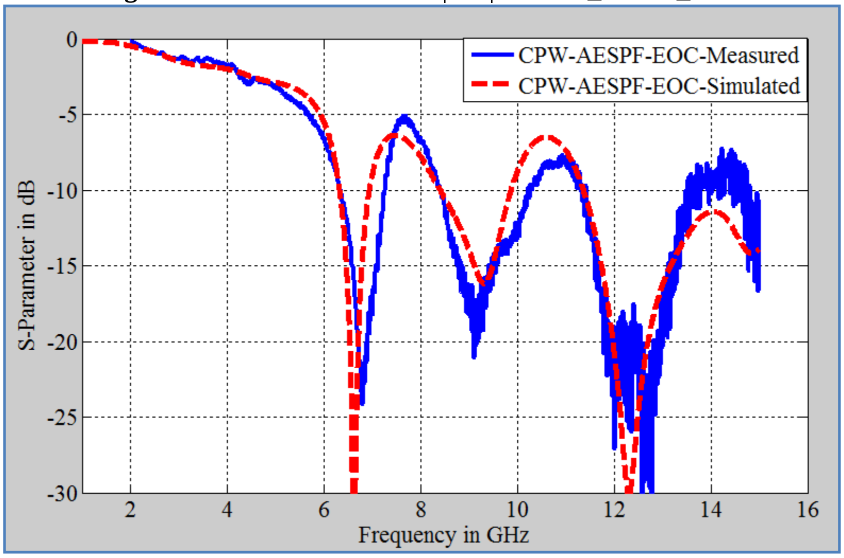


Fig. 16 Simulated & measured |S11| of CPW_AESPF_EOC

5 CONCLUSION

The presented paper demonstrates in details how to design a CPW filtenna structure to achieve the required operating passbands and stopbands within the desired frequency spectrum. This was carried out through two main steps. The first step is to use arbitrary slots located near the edge of the selected patch. The second one is to use a Reconfigurable Ground Structure "RGS". This includes EOC, ESC, STOC, and ATOC. Thus, two filtenna structures (CPW_HSPF and CPW_ESPF) have been proposed, investigated, and analyzed using the CST_MW Studio. Simulation results show that reconfigurable ground structure and patch slots can be used to tune and control the desired filtenna specifications. This includes the passbands and the stopbands of filtenna under investigation. Finally, to test and verify the proposed design methodology, four selected filtenna structures have been fabricated on standard lossy FR-4 and their parameters have been measured. Acceptable agreement between simulated and measured filtenna parameters has been achieved. Future work will include design, analysis and evaluation of a stripline filtenna chip module mounted on a microstrip motherboard.

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REFERENCES

Akkala Subbarao, Dr. S. Raghavan September 2011. A Miniaturized Ultra Wideband Slot Antenna with Band Notched Characteristic, International Journal of Microwave and Optical Technology, Vol. 6, No.5, IJMOT-2011-6-185 © 2011 ISRAMT.

Anvesh Rajput, Dharmendra Verma, Jai Kishan, Tejbir Singh, July, 2012. Design A Compact CPW-fed UWB Antenna with WLAN band notch characteristic, International Journal of Scientific & Engineering Research Volume 3, Issue 7, ISSN 2229-5518.

Dalia Nashaat, Hala A. Elsadek, Esamt Abdullah, Hadia Elhenawy, and Magdy Iskander, August 18-21, 2009. Ultra-wideband Coplanar Boat Microstrip Patch Antenna with Modified Ground Plane by Using Electromagnetic Band Gap Structure (EBG) for Wireless Communication. PIERS Proceedings, Moscow, Russia

Dau-Chyrh Chang, Ming-Yen Liu, Tsai-Tsung Chi, 2006. UWB Antenna with CPW-fed Monopole, Proceedings of ISAP2005, ISBN: 89-86522-79-9 94460 KEES, Seoul, Korea.

H. H. Wang, K. Yang, Z. Y. Lei and C. L. Li, 2011. Broadband Microstrip Antennas Using Coplanar Feed-Line, Progress In Electromagnetic Research Letters, Vol. 20, 129-136

Hussein Hamed Mahmoud Ghouz (Ghouz H. H. M.), October 2012. New Compact Microstrip Patch Filtenna Structures with Partitioned Ground for 3G/4G Applications, International Journal of Engineering & Technology IJET-IJENS, Vol. 12 No. 05, 128405-9292-IJET-IJENS

Hussein H. M. Ghouz, Mohamed Sayed Ali and Ahmed Raafat Fouad, 2013, A Novel Compact Ultra-wideband Monopole Microstrip Filtenna, Journal of Applied Science, 13(7), 1106-1111

M. R. Kamarudin, P. S. Hall, F. Colombel, and M. Himdi, 2010, Electronically Switched Beam Disk-Loaded Monopole Array Antenna, Progress in Electromagnetic Research, PIER 101, 339-347

Reham Zaghloul, and Hussein H. M. Ghouz July, 2013. A New Compact Multi Resonance H-Patch Filtenna, IEEE International Symposium on Antennas and Propagation and USNC-URSI National Radio Science Meeting Vol. 3187, pp. 978- 979, Orlando, Florida, USA

Reham Zaghloul and Hussein H. M. Ghouz, February 2014. Novel Compact Microstrip Filtenna Structures, International Refereed Journal of Engineering and Science (IRJES), Volume 3, Issue 2, PP.104-114

S. Natarajamani1, S K Behera1, S K Patra1 & R K Mishra, 2009. CPW-FED Octagon Shape Slot Antenna for UWB Applications, International Conference on Microwaves, Antenna, Propagation& Remote Sensing, Jodhpur.

S. Tu, Y. C. Jiao, Y. Song, and Z. Zhang, 2009, A Novel Miniature Strip-Line Fed Antenna with Band-Notched Function for UWB Applications, Progress in Electromagnetics Research Letters, Vol. 10, 29-38

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