Corrections to "A 28-GHz Low-Power Phased-Array Receiver Front-End With 360° RTPS Phase-Shift Range"

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THIS Letters corrects errata in the above paper [1]. The minimum rms phase error for the RTPS stand-alone [1, Table I] and for the front-end [1, Table II] computed as per the approach in [2] (with a zero average phase error) are 1.5° and 1.4°, respectively. The measured rms error of the RTPS across frequency is shown in Fig. 1. Table I presents updated comparisons with state-of-the-art phase shifters and corrects errors in reference numbers in [1, Table I]. Comparisons with mm-wave phased array front-ends are shown in Table II. This work achieves 360° phase shift with low loss variation.

TABLE I
STATE-OF-THE-ART mm-WAVE PHASE SHIFTERS

Approach [Reference]	Series RTPS Wu, RFIC [17]	Hybrid Meng, VLSI [36]	RTPS Natarajan, TMTT [7]	STPS Shin, MCW Letters [20]	This work
Process	180nm CMOS	65nm CMOS	130nm BiCMOS	65nm CMOS	65nm CMOS
Freq.(GHz)	24	60	94	28	28
Phase Range (°)	360°	360°	180°	360°	360°
Phase Resolution	Continuous	11.25°	11.25°	22.5°	11.25°
RMS Phase Error (°)	NA	4.4°	∼2.5°	8.98°	1.5°
Insertion Loss (dB)	10.1 to 12.5	12.3 to 16.3	6.9 to 7.9	5.6 to 7.6	7.45 to 8.05
Max gain error (dB)	1.2	2	0.5	1	0.3
Return Loss (dB)	20	13	NA	12	6.7
Area (mm^2)	0.33	0.094	0.12	0.23	0.16

TABLE II
STATE-OF-THE-ART mm-WAVE FRONT-END

[Reference]	Natarajan, ISSCC [37]	Yu, JSSC [38]	Yu, SiRF [39]	Min, JSSC [13]	Kodak, RFIC [40]	This work
Process	120nm SiGe	65nm CMOS	90nm CMOS	120nm SiGe	45nm CMOS SOI	65nm CMOS
Freq.(GHz)	60	61	60	34	27	28
Phase Range (°)	360°	360°	360°	360°	360°	360°
Phase Resolution	45°	22.5°	Continuous	22.5°	11.25°	11.25°
RMS Phase Error (°)	NA	7°	NA	<4°	4°	1.4°
Gain (dB)	14	12	11.3	11	12.2	9.5
Gain variation (dB)	±1.2	±1.7	±1.85	±1.5	±1	±0.4
P1dB (dBm)	-33.5	-16	-20	-28	-8	-22
NF (dB)	<6.9	<7.2	6.3	<3.4	4	<5.5
Power consumption (mW)	66	<78	18	11	42	10
Area (mm^2)	4.63	1.6	0.89	0.3	1.75	0.32

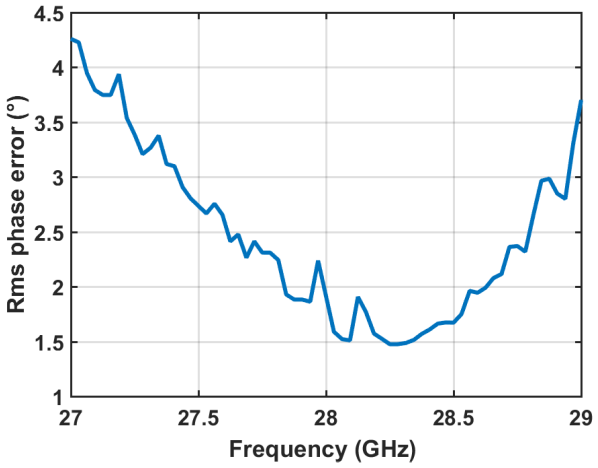

Fig. 1. Measurements of the RTPS rms phase error across the frequency.

Manuscript received August 12, 2017; accepted August 23, 2017. Date of publication September 20, 2017; date of current version December 12, 2017. *(Corresponding author: Robin Garg.)*

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Digital Object Identifier 10.1109/TMTT.2017.2748946

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[1] R. Garg and A. S. Natarajan, "A 28-GHz low-power phased-array receiver front-end with 360° RTPS phase shift range," *IEEE Trans. Microw. Theory Techn.*, to be published.

[2] *Phase Shifter RMS Phase Error*. Accessed: Jul. 7, 2017. [Online]. Available: https://www.microwaves101.com/encyclopedias/phase-shifter-rms-phase-error