0.18 μm E/D-mode pHEMT using I-line Photolithography for Microwave Application

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Abstract

A high performance 0.18 μm gate length enhancement and depletion mode (E/D-mode) pseudomorphic high electron-mobility transistor (pHEMT) MMIC has been demonstrated using manufacturable cost-effective I-line stepper photolithography with reliable shrinkage process. Figure 1 shows the SEM cross-section picture of this 0.18 μm E-mode pHEMT.

The performance of 8 × 50μm E-mode pHEMT device is shown in Figure 2 and Figure 3. Figure 2 shows the variable gain and noise figure under V_{DS} = 3.0 V and V_{GS} = 0.45 V bias conditions. The data were collected from five sites of the wafer. The available gain is 13.9 ± 0.93 dB and noise figure is 0.298 ± 0.028 dB at 6 GHz. Linearity performance with biasing V_{DS} = 4 V and V_{DS} = 5 V is shown in Figure 3. The measured large signal gain is about 16dB and OIP3 is about 35 dBm. Device specification is shown in Table 1.

The proposed process can be applied to microwave applications including low-noise amplifier and power amplifier…etc. The bias circuit for communication products would be less complicated.

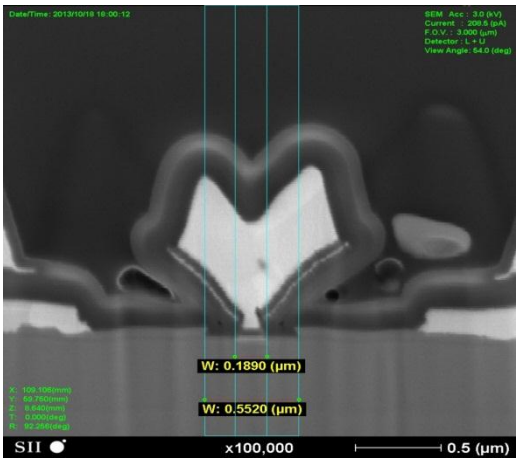

Figure 1: 0.18 μm T-gate profile on E-mode pHEMT

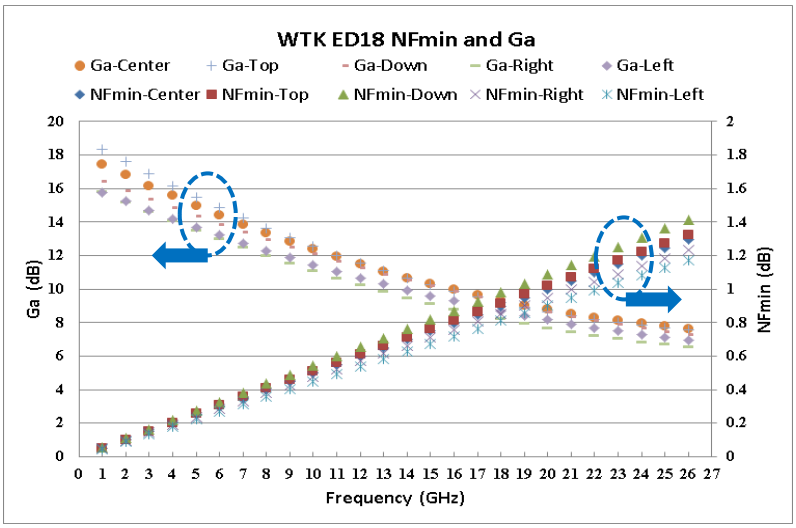

Figure 2: Measurement results of associated gain and minimum noise figure.

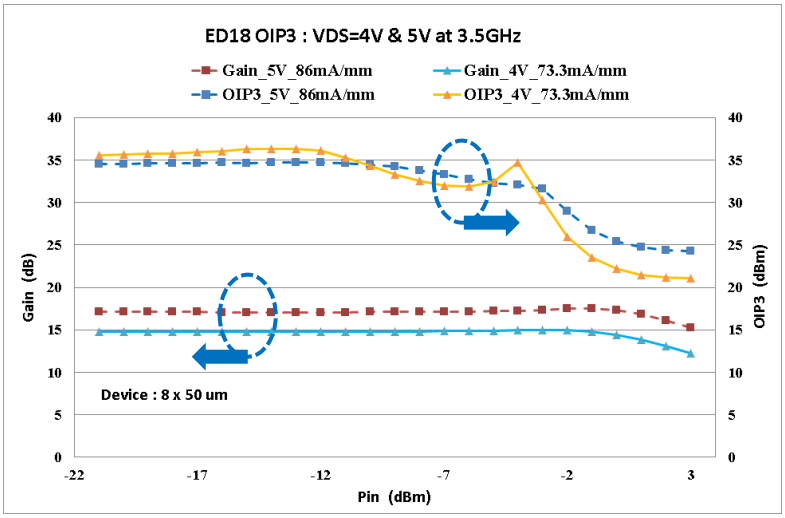

Figure 3: Measurement results of large signal gain and OIP3.

Table 1: Device specification of 0.18 μm ED-mode pHEMT

	E-Mode Device (0.18 μm)			D-Mode Device (0.5 μm)		
Parameter	Target	LSL	USL	Target	LSL	USL
V_{th}/V_p (V)	0.3	0.2	0.4	-1	-1.2	-0.8
I_{dss} (mA/mm)	1.0E-04	-	0.1	300	240	360
Gm_{max} (mS/mm)	850	750	950	350	280	420
Id_{max} (mA/mm)	450	360	-	450	360	-
BV_{gd} (V)	12	8	-	16	12	-
R_{on} (Ohm-mm)	1.2	-	2.0	1.0	-	1.5
f_T (GHz)	90	-	-	33	-	-
f_{Max} (GHz)	140	-	-	90	-	-