of how good could be the S-parameter fitting (small signal) with a topology that is that of Figure 2 of [1]. The Ph.D. thesis of one of the authors (Dr. Entrambasaguas) [4] was devoted to the frequency dispersion of the elements of small signal models of MESFET transistors. He proposed a model to account for the transverse propagation in the transistor, which, according to him, was the responsible for the frequency variation of the circuit elements. This model consisted of the parallel connection of a number of sections consisting each one of a basic model. The idea is that this basic model is only valid for a MESFET with very small gate width. He proposed as basic model two topologies, being one of them the one he had presented in [3] (the same of Fig. 2 of [1]). Again, he did not discuss the nonlinear analysis of the model, and all the measurements and the simulations were performed at small signal and one single bias point.

In my subsequent work on the same subject, apart from improving the parameter extraction method and the harmonic balance algorithms, I completed the model presented in [2], by considering all four charge and current generators and using the formalism of Y-parameters that Camacho *et al.* presented in [3] (equations (1) to (7) of [1]). In due recognition of their work, I referenced them in all my publications, including [1]. In this case, however, I wasn't aware that referencing to the Ph.D. thesis of Dr. Entrambasaguas [4] could be misunderstanding for a reader who did not know the Spanish microwave community. It might seem as if I had been the advisor of the Ph.D. thesis of Dr. Entrambasaguas and the paper [1] was simply a synopsis of it. I am sorry for that misunderstanding, although I still consider that their work was properly referenced in [1], since it clearly states "proposed previously in [8]".

Referring to [5] of which the authors of the comments above complain that "perhaps not surprisingly" there is no reference to their previous publications, it is worth noting that [5] is not devoted to presenting new aspects of nonlinear modelling, but to making a review of the results obtained in measurement and modelling of transistors by our laboratory and a German one, in the frame of an European collaboration. The references are inserted to address the interested reader to where he (she) can obtain more information on the procedures.

Perhaps it is too optimistic to claim that my paper is a new approach for nonlinear modelling, but in any case it is not their approach, because, as it has been apparent from the previous paragraphs, they don't have any, at least regarding nonlinear modelling.

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Comments on "Optimum Noise Measure Terminations for Microwave Transistor Amplifiers"

Ji-Chyun Liu, Sheau-Shong Bor, and Po-Chiang Lu

Continued from the above letter [2], it is found that the determination of the stable region in Fig. 2 of the paper is another incorrect one.

Generally, the input stability circle is plotted by using

$$|\Gamma_{\text{out}}| = \left| S_{22} + \frac{S_{12}S_{21}\Gamma_s}{1 - S_{11}\Gamma_s} \right| = 1 \tag{1}$$

This time, in the circle of (1), if $|S_{22}| < 1$, then $|\Gamma_{\text{out}}| < 1$ when $\Gamma_s = 0$. Restated, the center of Smith chart represents a stable operating point in the stable region [1]. Based on the given parameters of NE71083, $|S_{22}| = 0.616 (< 1)$, the value of Γ^*_{om} lies inside the stable region without doubt.

The output stability circle is plotted by using

$$|\Gamma_{\text{in}}| = \left| S_{11} + \frac{S_{12}S_{21}\Gamma_l}{1 - S_{22}\Gamma_l} \right| = 1 \tag{2}$$

This circle can be transferred it to the source plane by using output-match, $\Gamma_l = \Gamma^*_{\text{out}}$ ($= S^*_{22}$ when $\Gamma_s = 0$); if $|(S_{11} - \Delta S^*_{22})/(1 - |S_{22}|^2)| < 1$, then $|\Gamma_{\text{in}}| < 1$. Similarly, the center of Smith chart represents a stable operating point in the stable region. However, based on the given parameters, $|(S_{11} - \Delta S^*_{22})/(1 - |S_{22}|^2)| = 1.784 (> 1)$, the center of Smith chart is not a stable operating point. Thus, the value of Γ_{out} lies outside the stable region. This is a incorrect determination in the paper

When designing a matched amplifier where both input and output stability conditions are to be considered simultaneously, the cross-over region (shown in Fig. 1) is therefore considered as the unconditional stable region.

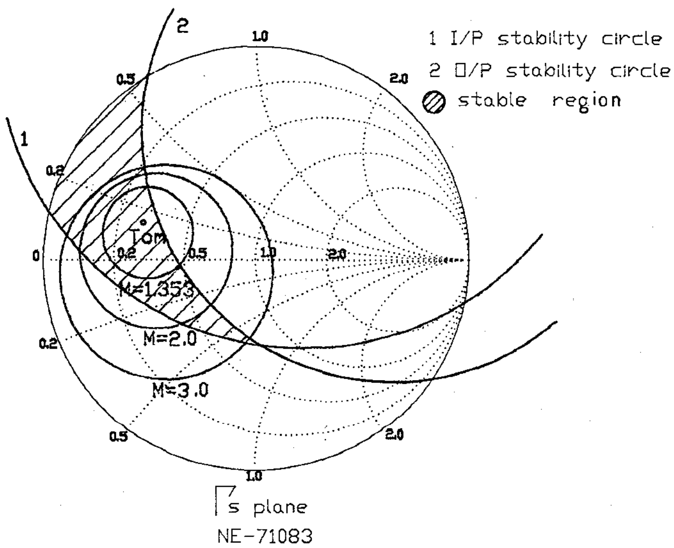

Fig. 1. The stable region determined by both input and output stability circles in source plane.

Manuscript received April 6, 1992; revised November 10, 1992.

The authors are with the Department of Electrical Engineering, Chung Cheng Institute of Technology, 33509, Ta-Hsi, Tao-Yuan, Taiwan, R.O.C.

IEEE Log Number 9208357.

0018–9480/93$03.00 © 1993 IEEE

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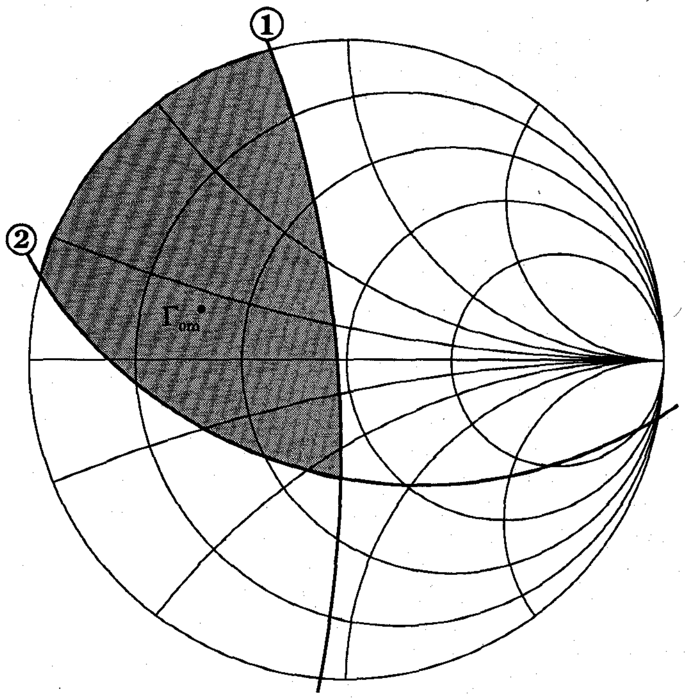
Reply to "Comments on Optimum Noise Measure Terminations for Microwave Transistor Amplifiers"

D. K. Paul and P. Gardner

The commentators now assert that the stable region was calculated incorrectlyin the paper. **This is not true.** It is perfectly valid to determine the stable region by plotting the input stability circle in the Γ_s plane and the output stability circle in the Γ_l plane, where Γ_l is the output load reflection coefficient. In Fig. 2 of the paper, both circles were plotted, for convenience and economy of journal space, on the same Smith chart. Stability was then verified by confirming that the proposed input and output terminations were in the stable regions in their respective planes.

In (1) and (2) of the latest comments, the commentators correctlyreproduce the well known first lines in the derivation of the equations for the input and output stability circles. However, the meaning of their subsequent comments is obscured somewhat by poor English. They appear to be suggesting a method for determining the stable region in the Γ_s plane, in the special case where, for any input termination, the output termination is always adjusted to give a conjugate match. However, instead of following through this line of reasoning, they proceed to reproduce the input and output stability circles on the same chart. They assert, **incorrectly,** that the region **outside** the output stability circle is stable. This is **clearly not true,** because the origin of the Smith chart is {\mbi{inside}} the circle and $|S_{22}| < 1$. What their analysis does show is that if $\Gamma_s = 0$, and the output is conjugately matched, then $|\Gamma_{\text{in}}| > 1$. (**It should be pointed out, however, that they have calculated the actual value of** $|\Gamma_{in}| incorrectly$). They then proceed to delineate a region between the two stability circles. **This is at best an obscure mathematical abstraction, since the two circles are in fact in two totally different spaces.**

We believe that what the commentators intended to do was to plot the locus ofΓ_s for which a conjugate match on the output port would result in $|\Gamma_{\text{in}}|=1$. We calculate that this circle has its center at the point with magnitude 3.65, angle $-175°$ and has radius 3.64, as shown in Fig. 1. Thus the origin of the Smith chart lies just outside the circle. Since we know from the preceding discussion that for $\Gamma_s = 0$, a conjugate match on the output gives $|\Gamma_{\text{in}}| > 1$, the stable region is **inside** this new circle.



(1) Input stability circle
(2) Input stability circle, given a conjugate output match
Shaded area shows the stable region.

Fig. 1. Stable region in the source reflection coefficient plane.

The other boundary of the stable region is defined by the conventional input stability circle, as discussed in the original paper, and as shown in Fig. 1 of this reply. Then, given that the output is to be conjugately matched, the criterion for stability is that the reflection coefficient, Γ_{om}, of the input terminal should lie within the stable region, as indeed it does. Unlike the commentators, we do not concern ourselves with the position of Γ_{out} relative to this region, since the stable region has been plotted in the Γ_s plane.

This alternative method of analysis thus confirms the assertion in theoriginal paper, that if the input is terminated in Γ_{om} and the output is conjugately matched, then the device **is stable at both ports.**

If Liu, Bor and Lu intend to make a career out of looking for errors in sevenyear old published papers, we would respectfully suggest that they take more care with their analysis and the presentation of their arguments. We would further suggest that they would be better employed in pursuing some new and forward looking research of their own.

Manuscript received December 3, 1992.
The authors are with Department of Electrical Engineering & Electronics, The University of Manchester Institute of Science & Technology, P.O. Box 88. Sackville Street, Manchester M60 1QD. United Kingdom.
IEEE Log Number 9208358.