APPENDIX

The OSA actual or effective optical noise bandwidth is important in the measurement of noise figure due to its influence on measurement accuracy. The displayed OSA spectral resolution is not actually used in the noise figure calculation. The following equation is the noise figure given by the Anritsu OSA which only includes the signal-spontaneous beat noise.

$$NF = 10 \log \left(\frac{P_{ASE}}{h.\upsilon.G.\Delta\upsilon_s} \right)$$

where $\Delta\upsilon_s$ is the frequency band of OSA at P_{ASE} measurement, P_{ASE} is the ASE power within the optical bandwidth, G is the gain of the amplifier, h is Plank's constant with 6.626×10^{-34}, and υ_s is the signal frequency.

$$\upsilon_s = \frac{c}{\lambda_s \times 10^{-9} - \frac{Res_{real} \times 10^{-9}}{2}} - \frac{c}{\lambda_s \times 10^{-9} + \frac{Res_{real} \times 10^{-9}}{2}}$$

where Res_{real} is the actual resolution.

It is noted that the frequency band of OSA at P_{ASE} measurement is a function of actual resolution in OSA. Experiment is carried out to the test amplifier to investigate the effect of the actual resolution to noise figure measurement. OSA measures gain and noise figure with displayed optical resolution of 0.07nm. Each time when the gain and noise measurement is taken, the resolution calibration is carried out and its actual resolution is changed.

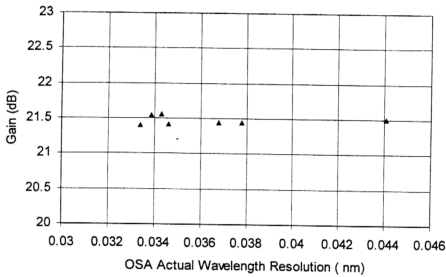

Fig.1 The small-signal gain as a function of actual OSA resolution.

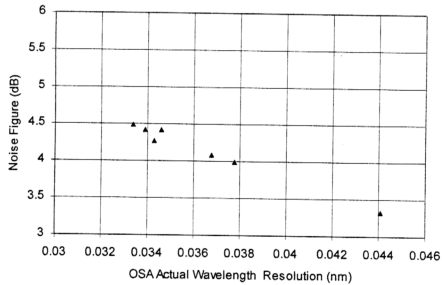

Fig.2 The corresponding noise figure as a function of actual OSA resolution.

Fig.1 and Fig.2 show the small-signal gain and its corresponding noise figure against the effective/actual OSA resolution. Fig.1 shows that the effective optical bandwidth is seen to have no significant influence to the amplifier gain.

The difference of gain within the actual OSA resolution region tested in the experiment is ±0.1dB. Therefore, it is shown that the gain is independent on the OSA actual resolution or OSA optical bandwidth. On the other hand, the corresponding noise figure decreases with increasing actual resolution as shown in Fig.2. The variation is relatively large with ±1.2dB. Hence, the actual resolution is considered and used in the calculation of noise figure instead of the displayed optical resolution.