



Application Note 004

TOF/Thickness Measurement

Introduction

Time-of-flight is the time taken by ultrasound to propagate from one reference interface to another interface.

There are three modes of time-of-flight measurement:

Normal Mode - TOF information is calculated from the crossing point of the follower gate to the peak in the data gate. This is the default setting.

Peak-to-Peak Mode - TOF information is calculated from the peak in the follower gate to the peak in the data gate. Disabled by default.

Edge-to-Edge Mode - TOF information is calculated from the crossing point of the follower gate to the crossing point of the data gate. Disabled by default.

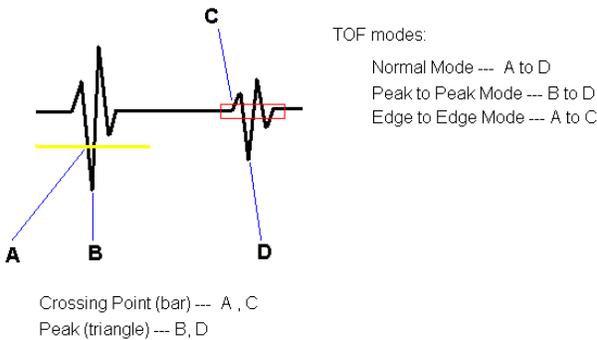


Figure 1: TOF measurement modes

Procedure

The procedure of TOF measurement is demonstrated by the following bonding layer thickness measurement.

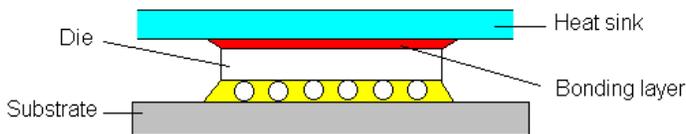


Figure 2: The thickness of the bonding layer is to be measured

As shown in **Figure.2**, the bonding layer is between the heat sink and the die. The gate set up for this application is illustrated in **Figure.3**. Data gate 2 (green box) is placed at the bottom of the bonding layer and follows the sub-surface follower (green line), which is placed at the top of the bonding layer. So the measured time-of-flight is the time taken by the ultrasound to propagate from the heat sink/bonding layer interface (SSF) to the bonding layer/die interface (data gate 2). If the acoustic velocity of the bonding layer material is known, its thickness can be calculated as:
 Thickness = TOF x Velocity/ 2.

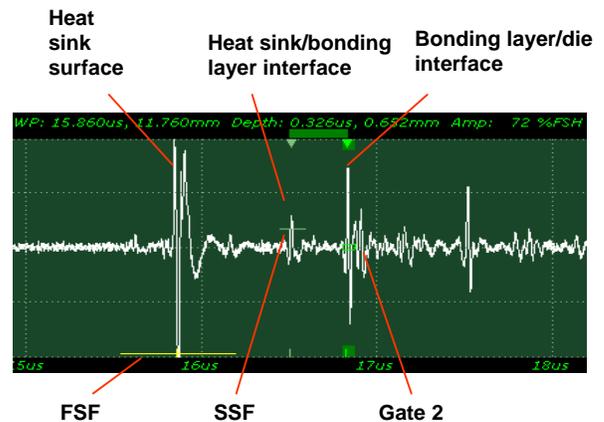
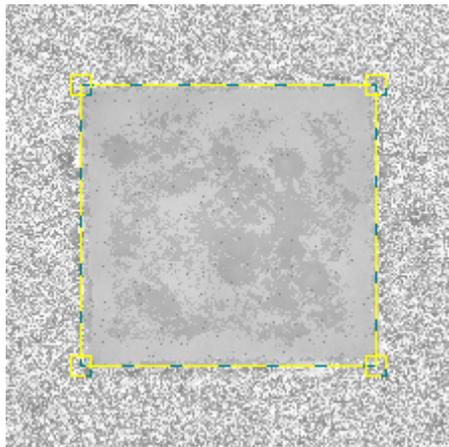


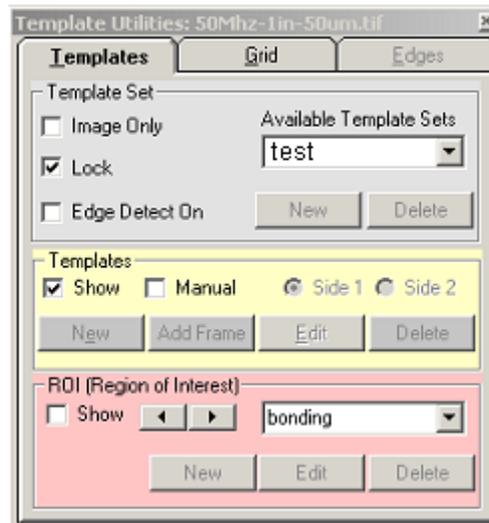
Figure 3: The green data gate follows the sub-surface follower

Thickness measurement

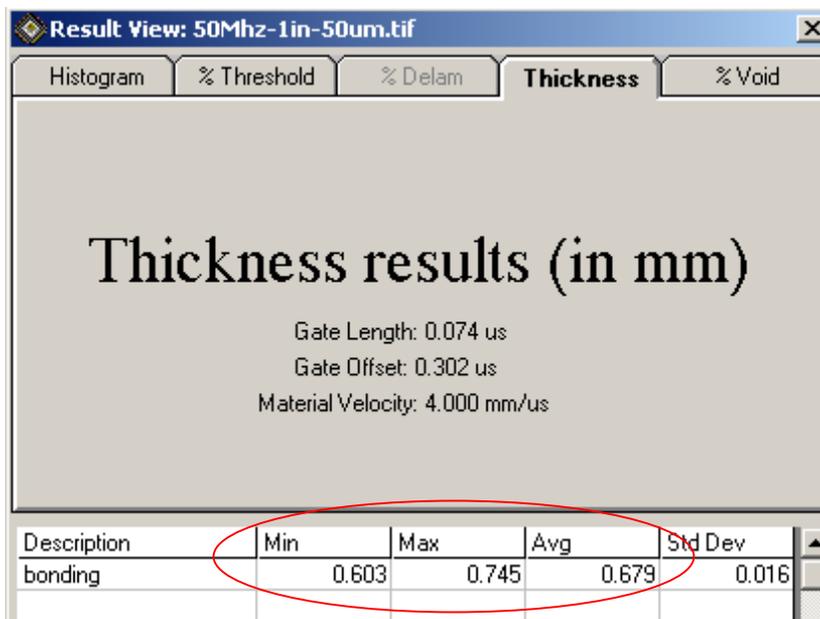
Following the procedure describe above, a time-of-flight image of the sample can be generated (**Figure 4a**). Instead of point-by-point measurement, templates (the yellow box) can be used to define the region of interest (**Figure 4b**), and thickness measurement can be obtained in terms of the minimum, maximum and average values in the region of interest (**Figure 4c**).



(a) Time of flight image



(b) Template set up



(c) Thickness measurement

Figure 4: Thickness measurement based on the time of flight image