# Program Package LAYERED Version 0.3 for Layered Substrate Structure

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## 1 Outline

This computer package consists of (i) EPSL to calculate the effective permittivity on the layered structure, (ii) VCALL to calculate the complex velocities and electromechanical coupling factor $K^2$ of Rayleigh and/or Leaky-SAWs on the structure, (iii) FEMSDL to calculate those on fully periodic metallic grating structures with finite thickness, (iV) SYNCL to calculate the input impedance per period of infinitely long interdigital transducer. These programs are based on the software EPS, VCAL, FEMSDA and SYNC, respecitively, and their usage are quite similar to their originals.

## 2 Usage

Type "epsl", "vcall", "femsdl" or "syncl" for execution.

1. "Enter File Name" where the output data will be stored. Note that, if the file already exists, the file will be overwritten and the former data will be erased.

2. "Material: LNOW(1), LNON(2), LNOK(3), LTOW(4), LTOS(5), LTOK(6), LBO(7), GAAS(8), QUARTZ(9), LGS(10), KNO(11), ZnO(12), AlN(13), PZT(14), Al2O3(15), Si(16), Diamond(17) & SiO2(18)" will be displayed, and "Enter Substrate material No." for specifying the bottom substrate material. If you enter other value, the program will be terminated.

3. "Enter Axis & Angle" for specifying the rotation of the substrate and "To proceed next step, enter 0 for axis". For example, if desired substrate cut and SAW propagation direction is specified by the Euler angles $(45, 30, -20)$ in degree, type

3,45 <CR>
1,30 <CR>
3,-20 <CR>
0,0 <CR>

4. "Enter Film material No." for speicfying the upper substrate layer substrate material.

5. Same with the step 3. Then the program prints the bulk wave velocities whose wavenumbers are parallel to the surface and the effective permittivity $\epsilon(\infty)/\epsilon_0$ of the substrate. If the piezoelectricity is decoupled, the program displays its situation and returns to step 2.

6. For FEMSDL and SYNCL, "Enter film thickness/p" for specifying upper layer thickness, where the $p$ is the grating pitch. For EPSL and VCALL, "Enter film thickness/wavelength".

7. Remaing steps are exactly the same with the original software. Please refer to their correponding manuals.