

# Using Ada for Semiconductor Assembly Equipment

**How ITEC uses Ada95  
in semiconductor  
assembly equipment**

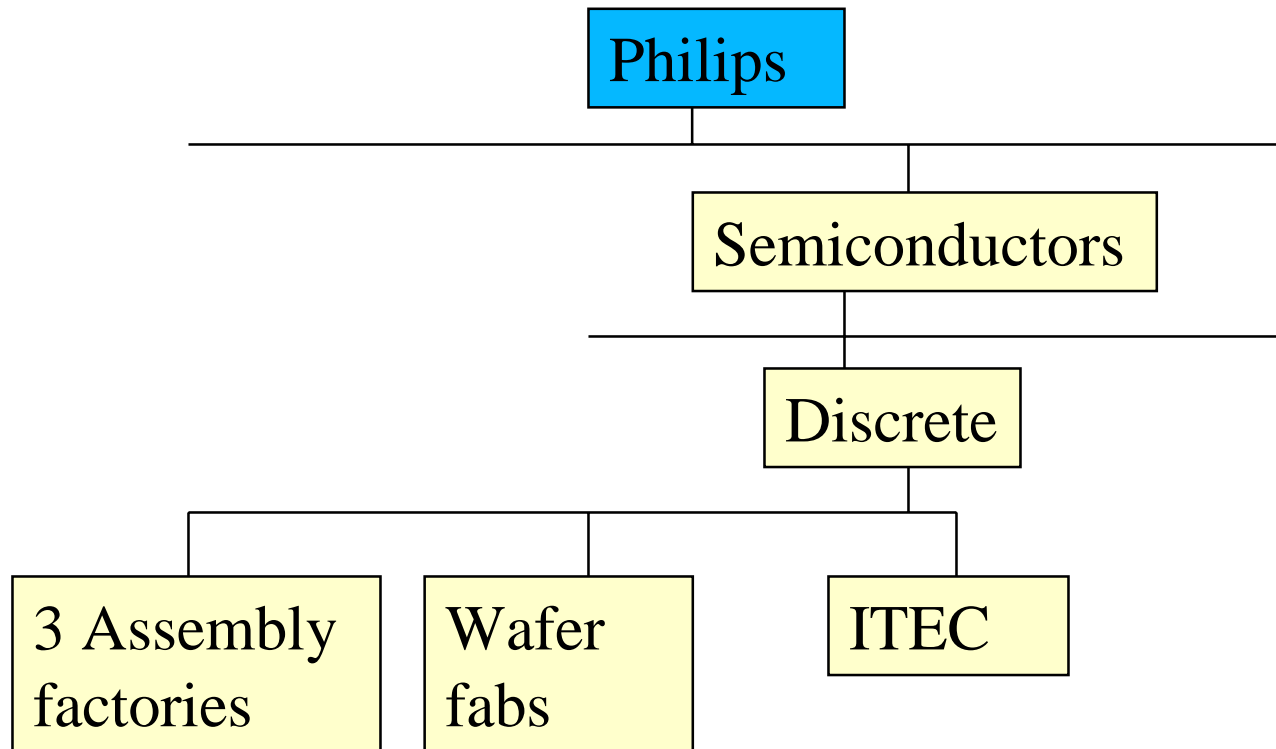
PS - XXX.XX.XX-1

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# ITEC within Philips

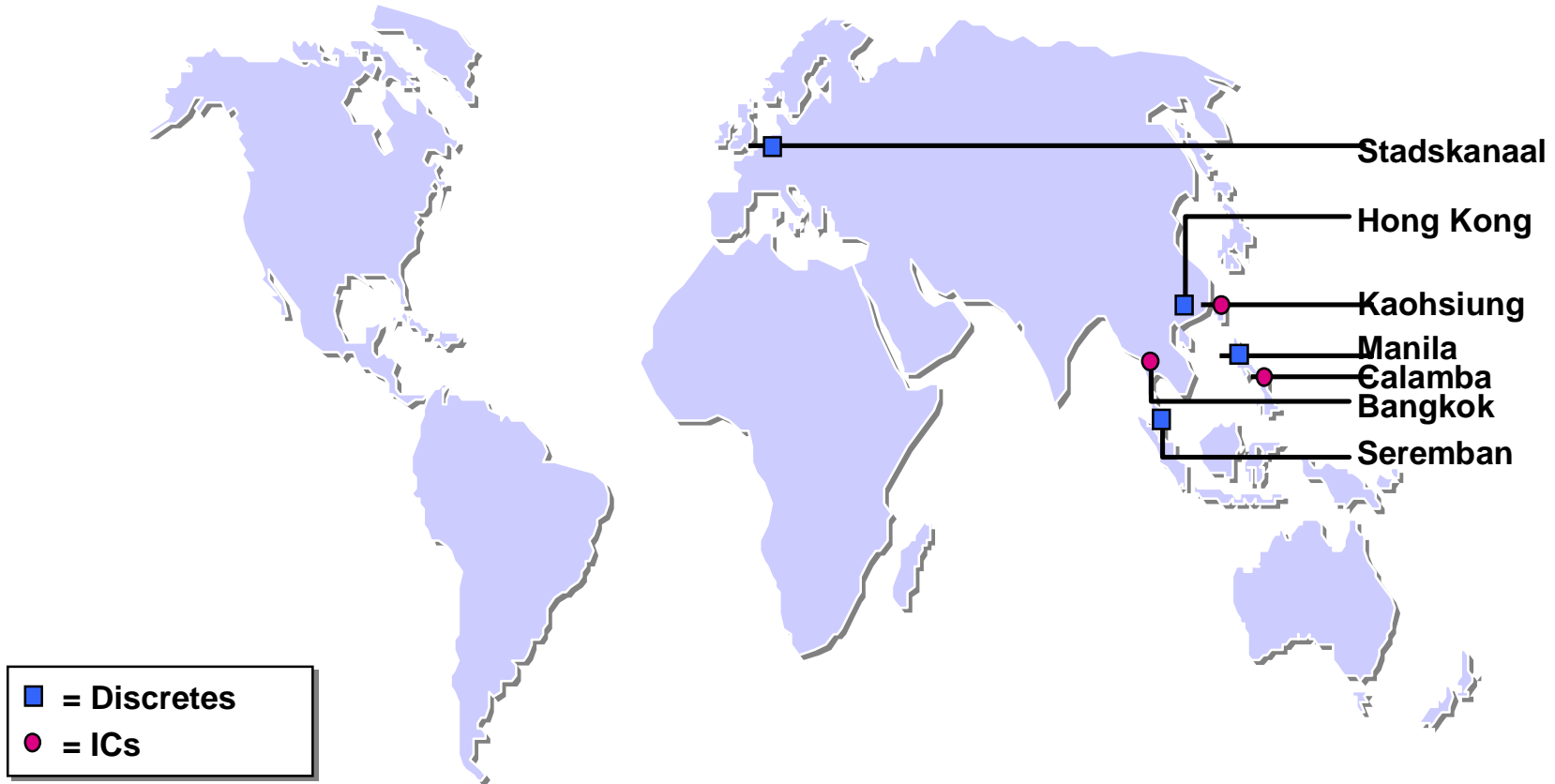


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# Assembly facilities, our customers



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# BIM line setup

**BIM: Break through In Manufacturing**

Endless  
leadframe



Adat

Phicom

Mould

Plate

Test,  
mark,  
tape

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# ITEC equipment

- **Adat: Die attach machine, takes die from wafer and solders it on leadframe**
- **Phicom: Wire bond machine, bonds gold and aluminum wires from die to leadframe**
- **Multiplunger: Mould products in plastic**
- **Parset: Tests devices to meet electrical specification**
- **Quad: Machine to cut and bend leads, laser mark, test and tape products.**

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# Started with Ada95 5 years ago

Assembly machines use RTL/2 on 68k, tester used pascal on VAXeln  
Converted code to Ada95 automatically

Reasons to start with Ada 95:

- Old code can be converted to Ada95 code
- Ada95 good programing environment compared with pascal
- GNAT available, based on gcc, lots of tools available

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# Platform Windows NT

## Why Windows NT:

- **Advanced system services**
- **Cheap, runs on cheap hardware**
- **Integrates well in office environment**
- **Realtime properties good enough**
- **Advanced GUI**

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# Selection of Ada95

## +++ positive

- **Conversion from rtl/2, pascal possible**
- **Very good from engineering point of view**
- **Finally good compiler (GNAT)**

## --- negative

- **Nobody uses it (in Philips), everybody does C**
- **One must know C anyway**

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# Typical Equipment control

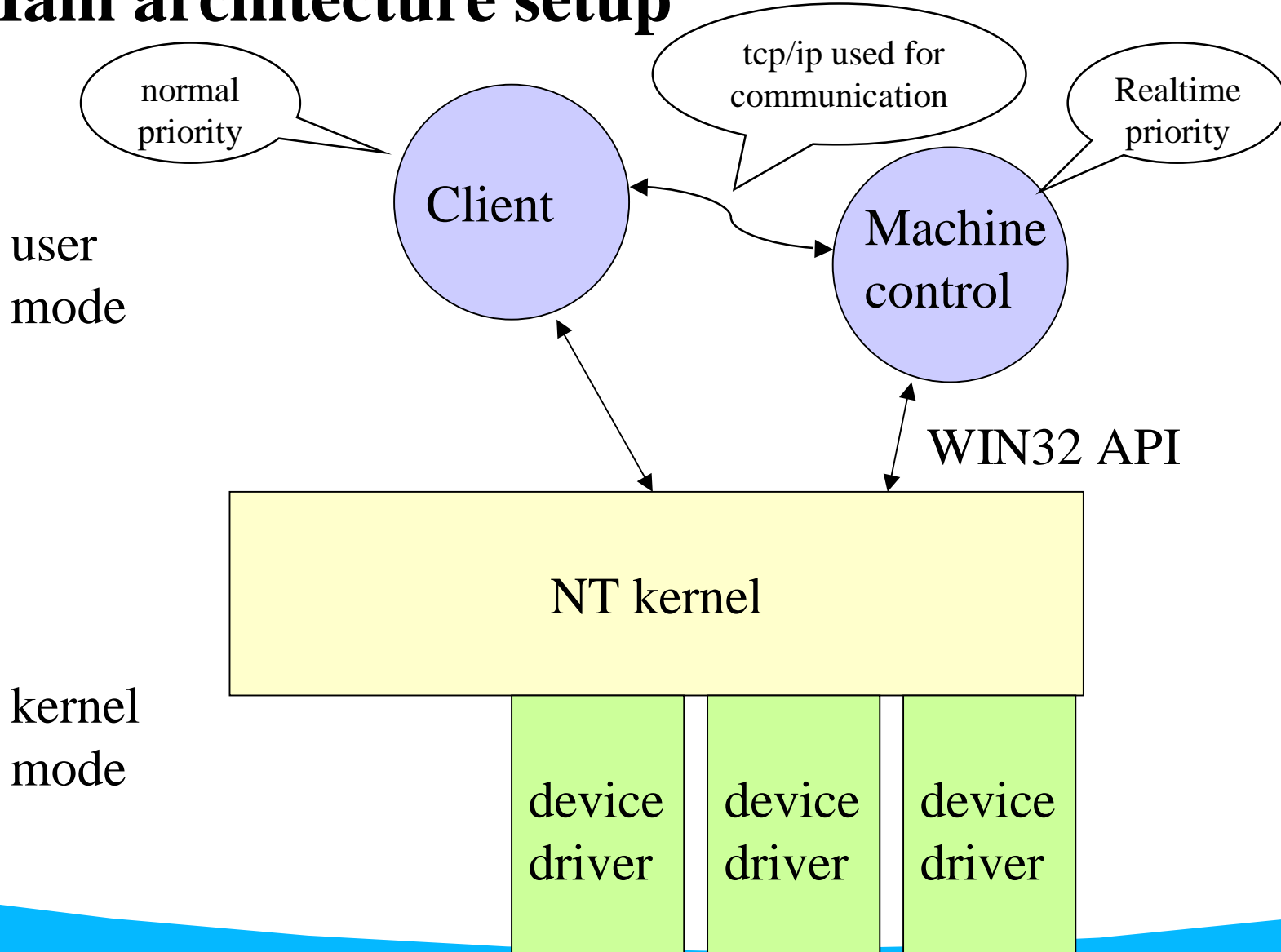
- **High end motion controllers using fast DSP's (9kHz cycle).**
- **Vision function: using frame grabber to get the image, then process it on the pc**
- **Machine control multithreaded (typical 30-50 threads)**
- **Integration with Shop Floor Control system**
- **Support of many variants**
- **Response time to external events <1ms**
- **Setup as client/server**
  - **Server performs the control**
  - **Client interacts with user**

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# Main architecture setup



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# Interface with hardware & interrupts

## Wrote special device driver for NT

- Allows user mode program to access physical memory
- Allows synchronization with interrupts
- User process can execute routine in kernel mode

## Response times: Interrupt to thread

- average 40 microsecond
- maximum 1 millisecond

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# GUI clients

- **Visual ITEC (Build with CLAW)**
- **Scope (build with CLAW)**
- **Curve tracer (build with gnatcom, gwindows)**

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# Visual ITEC used as GUI interface (1)

## **In design mode:**

**Allows to define screen layout. Select objects from application into screen.  
Can make buttons that give commands to applications. Buttons can also  
invoke other screens.**

## **In execute mode:**

**User makes use of screens defined.**

**Advantage: Application developer can focus on core of application.**

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## Visual ITEC used as GUI interface (2)

### Object types for Visual itec:

- Text objects
- Chart objects
- Life video objects
- Wafermap objects (gives view of wafer with die processed)

### Visual itec characteristics:

- Inquires server periodically to get its information
- Can run anywhere because of tcp/ip connection
- Can combine information from different servers in one form

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# Visual ITEC used as GUI interface (3)

The screenshot shows the Visual ITEC software interface. At the top, the title bar reads "Visual ITEC (C:\Itec\Release\Image\phicom\_automatic.vif)". Below this, the "PHICOM" logo is displayed along with "Software version : V2.301 14-SEP-2000 07:05:18.00", "Process program :", and "Temperature : 300". The "itec" logo is also present in the top right corner.

On the left side, there are several input fields and labels:

- Work station | Id
- State | State
- Sfc link
- Wire number: 1
- Product number: 1
- Bond single product: TRUE
- Pattern recognition only: FALSE
- UPM: 37
- Batch counter: 3903
- Shift counter: 3903
- Skip counter: 0

In the center, a grayscale image of a wire bond is shown. A red rectangular box highlights a specific area on the bond, indicating a detected defect or area of interest.

Below the image, the coordinates are displayed: X: 8191.2, Y: -5291.8, Z: 323.7.

At the bottom, there is a control panel with 12 function keys (F1-F12) and their corresponding actions:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
Start / Stop			Make "new ball"	Correct tooloffset	Toggle wireclamp			Form exit	Top menu		Continue

The date and time "15-SEP-2000 10:04" are displayed in the bottom right corner of the interface.

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# Scope debugging tool

## Scope architecture

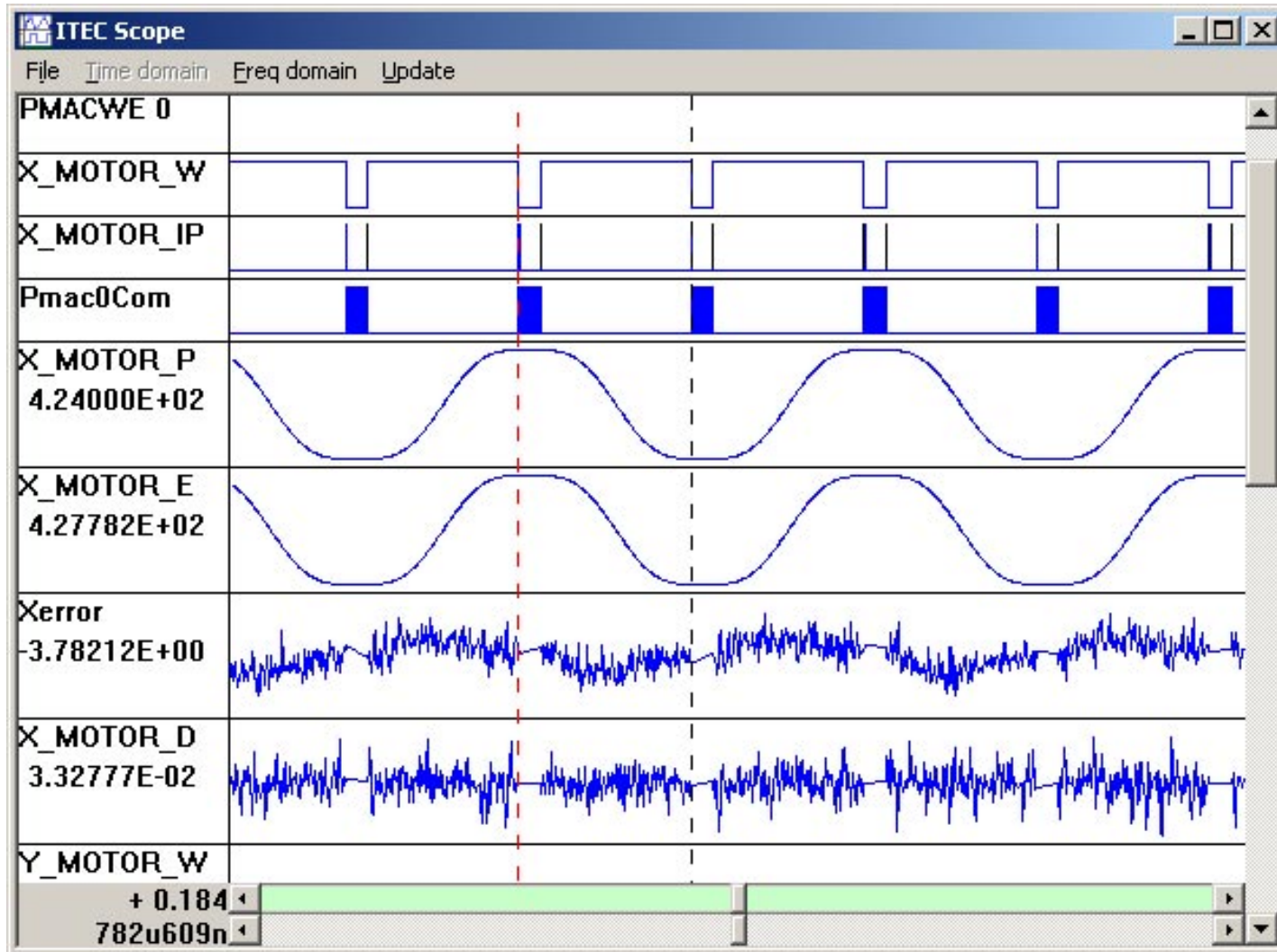
- In our application we use circular buffers to store events with their time. Such an object is called a probe.
- Application can put time stamps with boolean in them
- Application can put floating point value with time in them.
- To get timestamps, we use rdtsc of pentium
- Setting a timestamp is very fast  $\ll 1\mu s$
- Application has low priority server that allows client access to data
- Client displays data graphically

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# Conclusions

- **Ada95 is very good programming language**
- **Ada95 tasking features makes machine control much simpler**
- **Ada95 gives stable applications because of its build in protection mechanisms**
- **Ada95 made for proper software engineering**
- **Ada specs gives developer good idea of package content. When properly setup increases reuse of packages.**
- **In the beginning NT support was just enough. Getting better each year: stable gnat compiler, gnatcom, gwindows**

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