CHAPTER 5

SYSTEM IMPLEMENTATION

The die attach machine error detection system relates to both hardware and software. However, the most of details are software related. Structure of program must comply with both SECS standard and the requirements of equipment. The architecture of the program will be described firstly and followed by the host communications set up procedure on the ESEC die attach machine model 2007, and then structure of the error detection system.

5.1 Architecture of the program

The die attach machine error detection system is installed in the host computer as a software. The architecture of the program is shown as below.

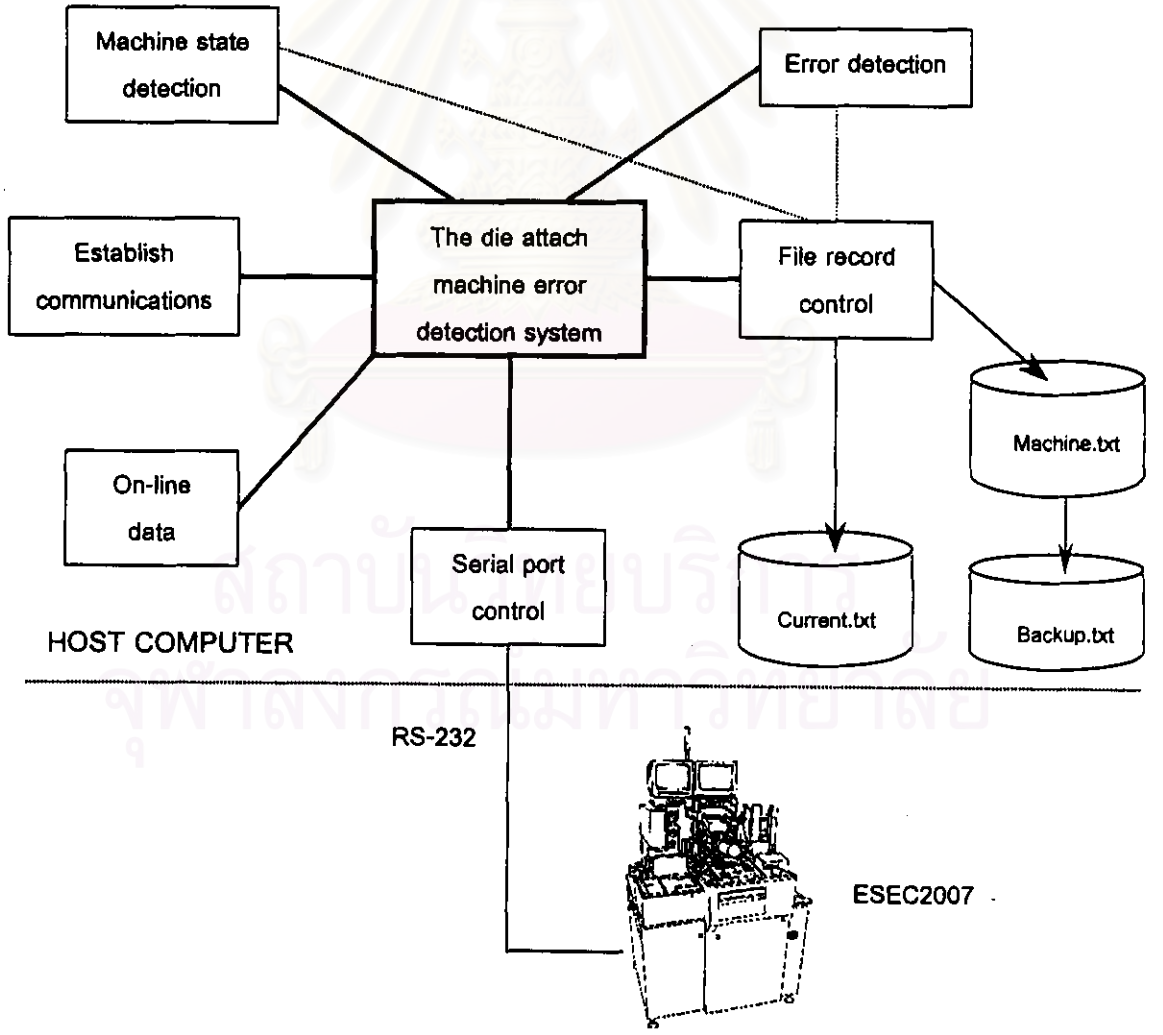

Figure 5.1: Architecture of the program

The die attach machine error detection system controls message transfer between a host computer and the ESEC die attach machine model 2007 through the function of serial port control. During the system operation, machine state and error detection is used as the main functions of the program. The data of machine state transition and errors are recorded into a text file, named "Machine.txt". In order to prevent loss of the recorded information, the data is copied to another text file, named "Backup.txt". Moreover, the system also records the current machine status in another text file so that the operator can verify the current machine state through the file name "Current.txt".

5.2 Host communications set up procedure

The host communications package is not automatically run after machine initialisation. Hence, the operator has to load this package when the host interface is required. After finish loading, the main window and function keys are as below.

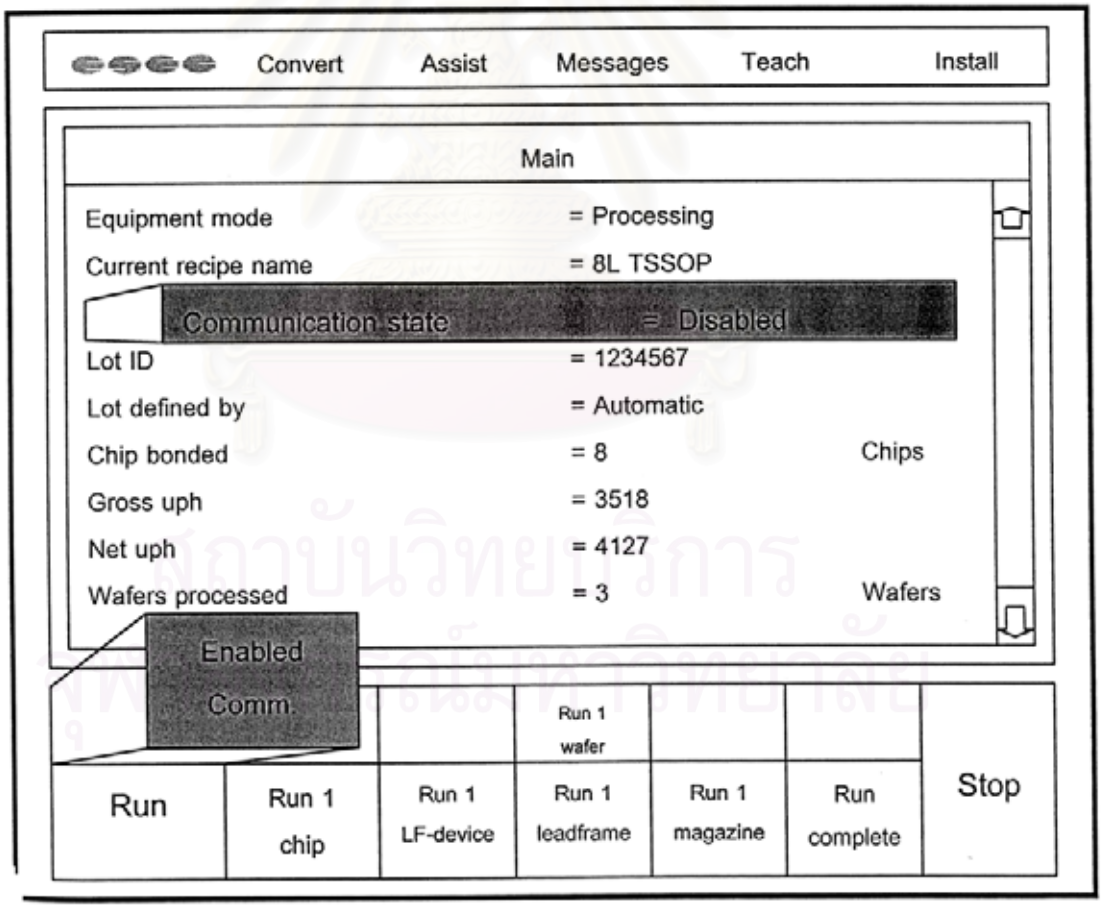

Figure 5.2: Main window and function keys after the program loading

A function key of Enable / Disable communications will appear with a status of communication state (Disabled). However, the parameters of host communications have to be defined and set before communication with host computer.

The following figures show important parameters of host communication on ESEC2007 and its default value.

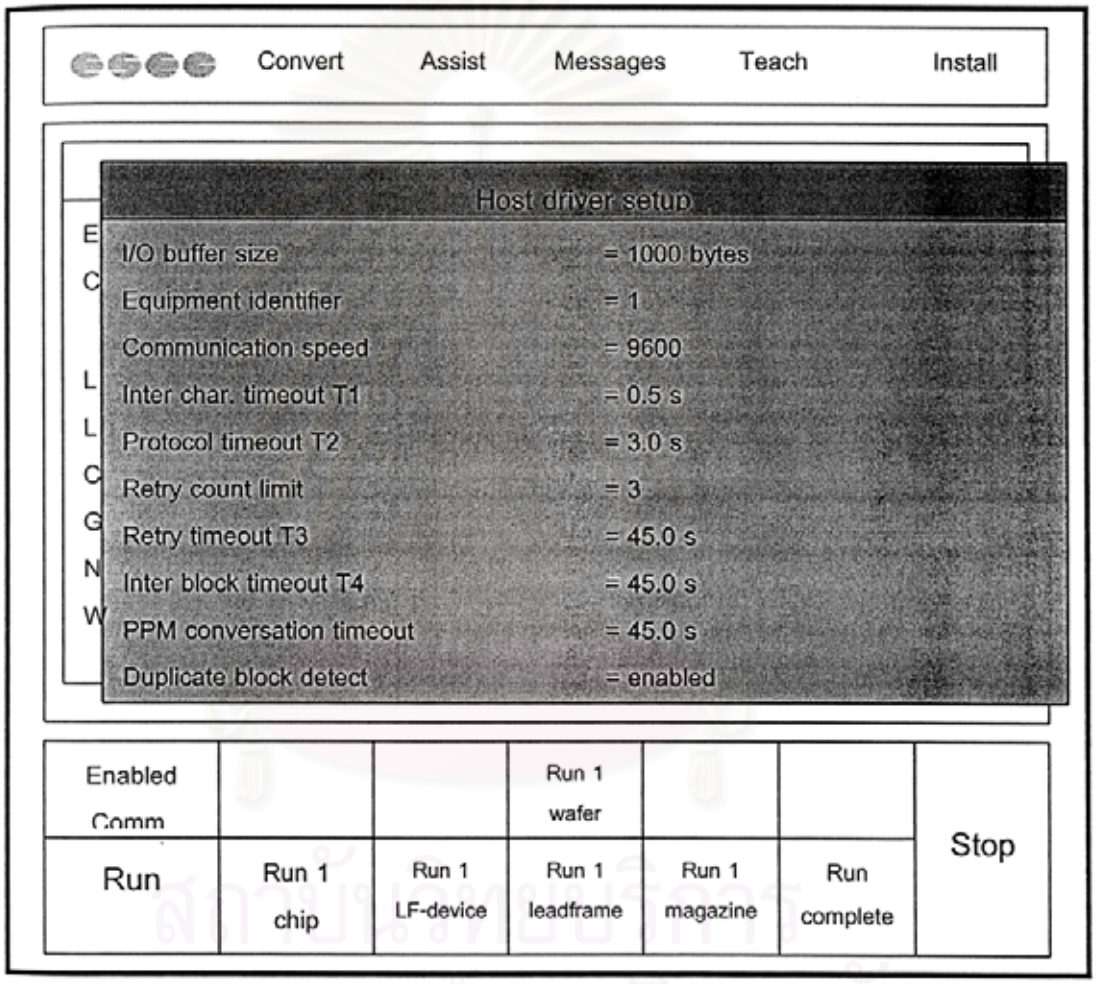

Figure 5.3: Host driver setup window and parameters

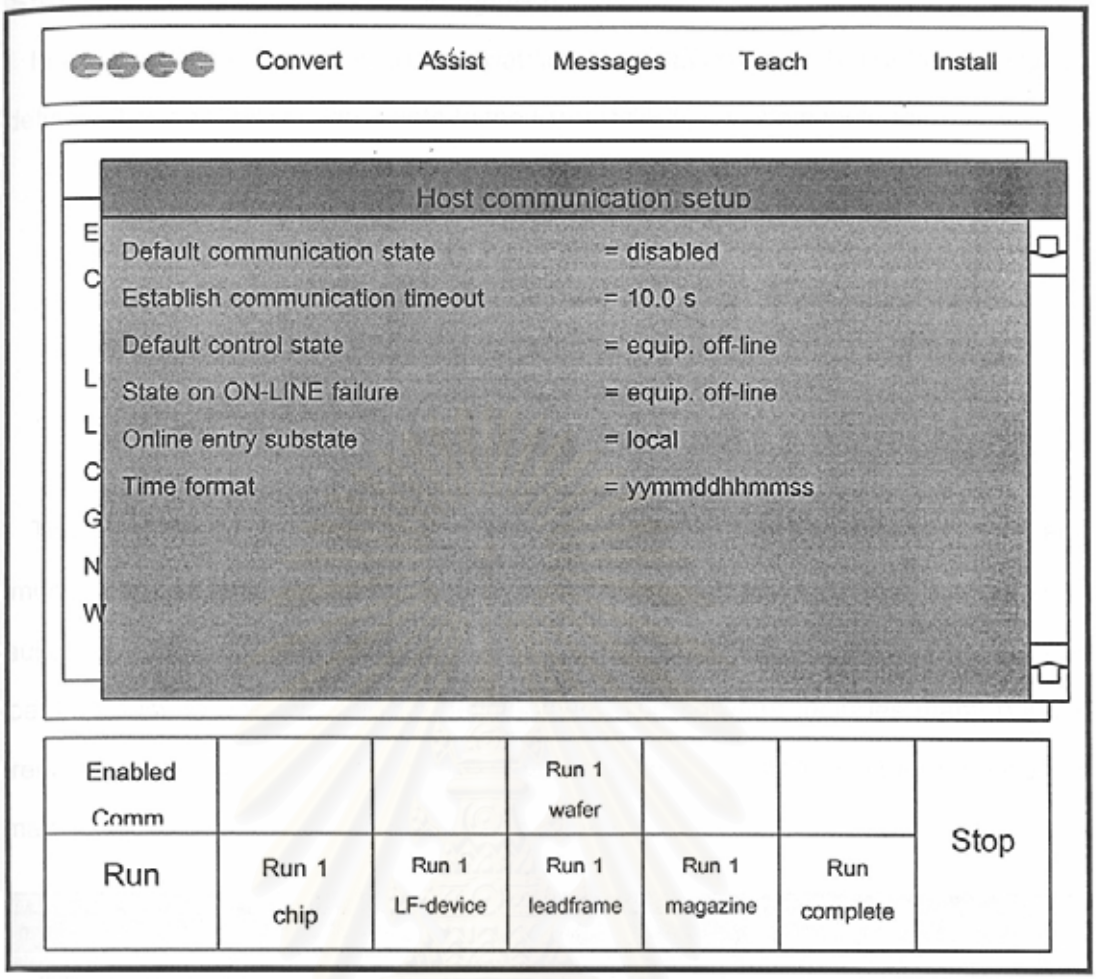

Figure 5.4: Host communication set up window and parameters

Since all parameters have been correctly defined, the communications between the equipment and host are possible. The serial connector must be installed in order to link them together. The next section is the explanations of the structure of die attach machine error detection system.

5.3 Structure of the error detection system

In Chapter 4, the communication capabilities of ESEC die attach machine model 2007 are defined. The capabilities that relate to the Error detection system include:

1) Establish communications
2) Control
3) Data collection
4) Alarm management and exception reporting
5) Material movement

The **"Die attach machine error detection system"** is the combination of all above communication capabilities. The **Microsoft Visual Basic version 6** is used for this application because it is Object-Oriented Program and designed to be Graphic User Interface (GUI). Hence, it is easy to use for program development. The software includes many parts with different purposes. The completed program is shown in **APPENDIX E**. Figure 5.5 illustrates the main window of the die attach machine error detection system.

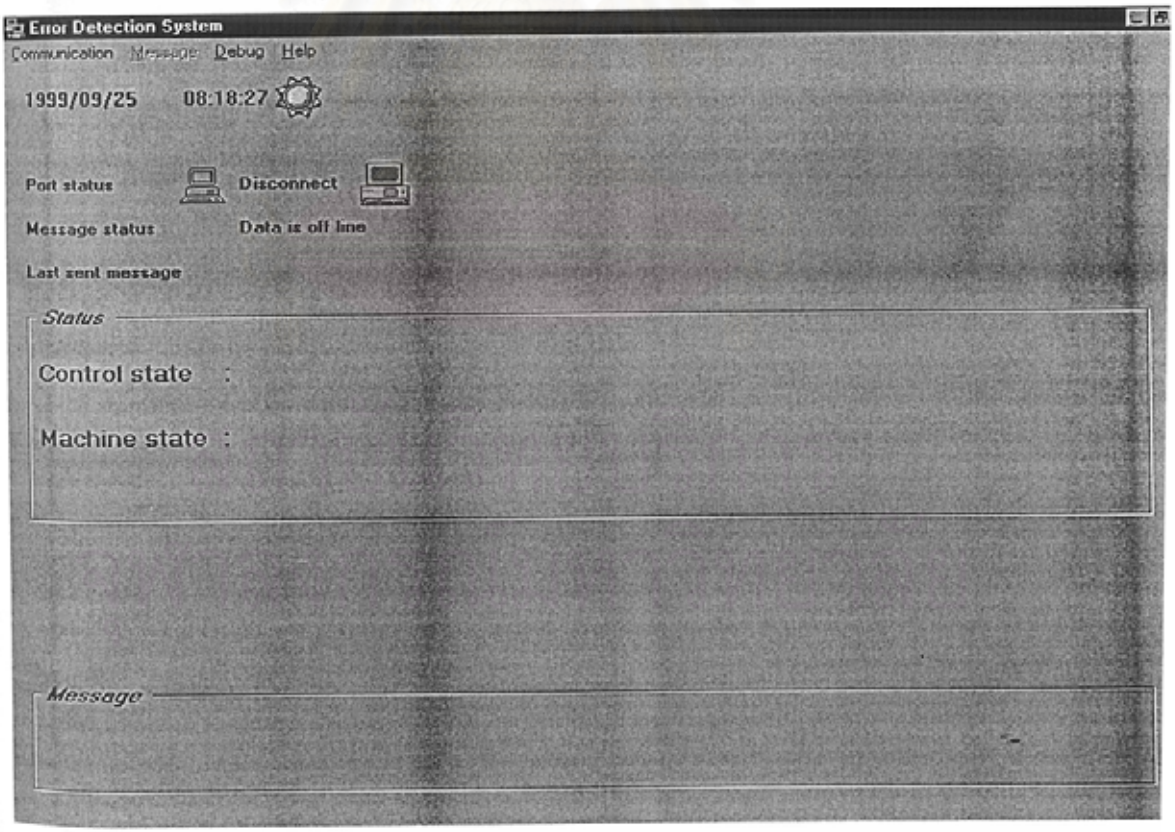

Figure 5.5: Main window of the die attach machine error detection system

Features of the error detection system includes:

1) Serial port connection
2) Establish communications
3) On line data
4) Machine state monitoring
5) Machine error detection
6) Material movement monitoring
7) Status variable value requisition

5.3.1 Serial port connection

Before starting the host communications, serial port has to be connected first. This is a logical connection. Port number for communications is defined with setting the appropriate properties. Communication properties shall be as below:

Baud rate	: 9600 bit per second (bps)
Parity check	: None
Data bit	: 8 bits
Stop bit	: 1 bit

5.3.2 Establish communications

Whenever the serial port is connected to both physical and logical, host communications is still impossible. The communications must be completely established. The Establish communications command will be selected from communication menu as illustrated in the Figure 5.6.

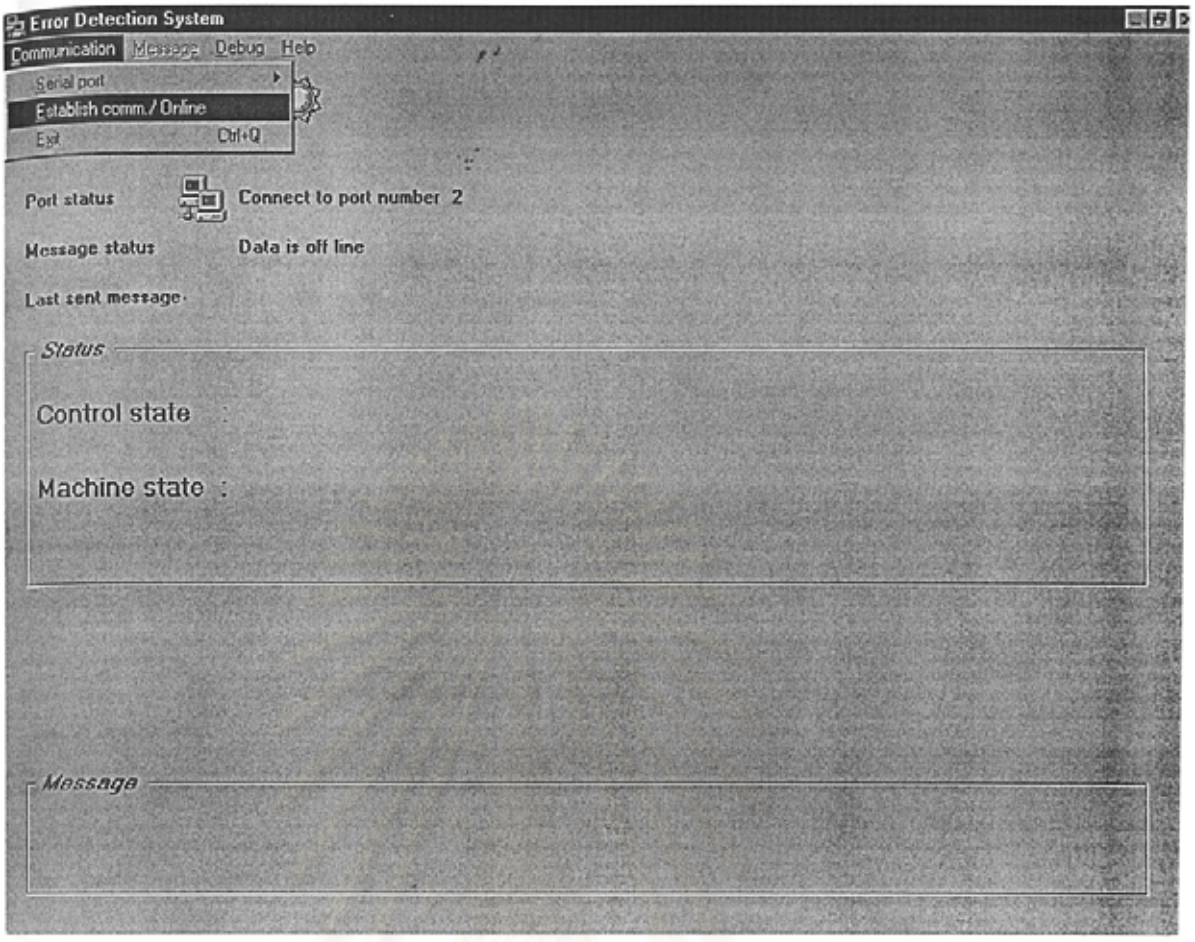

Figure 5.6: Establish communications command

The program waits for an Establish Communication Request (S1F13) from the equipment. If an S1F13 is received by the host, the S1F13 / F14 transaction will be opened so that an Establish Communication Request Acknowledge (S1F14) with COMMACK=0 is sent to the equipment as illustrated in the Figure 5.7. Hence, the S1F13 / F14 transaction is closed and the communication is successfully established.

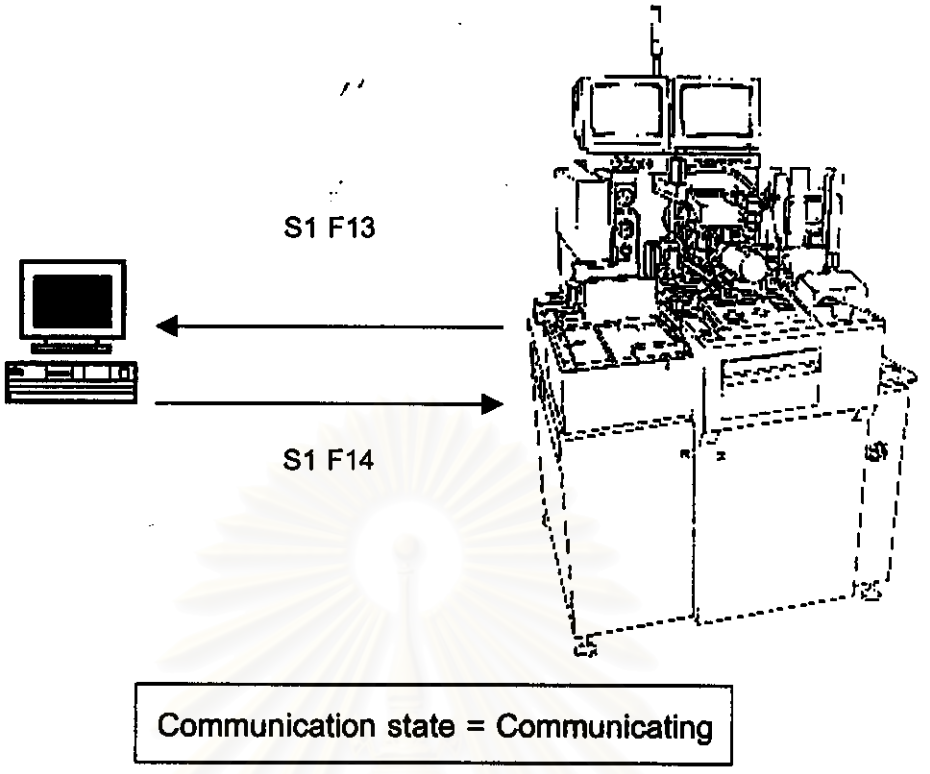

Figure 5.7: Establish Communications Request / Acknowledge

5.3.3 On line data

If the communications are successfully established, communications state on main menu of the equipment will change to be "Communicating", and a "On line" key appears as described in Chapter 4. In this state, the host communication interface is not completed yet. The control state is still off line so that all SECS messages except S1F13 are discarded by the equipment.

The "On line" button on front panel must be pressed by the operator so that an S1F1 message is sent by the equipment. The S1F2 must be replied from the host with empty list, the data is then on line. This activity can be shown in the following figure:

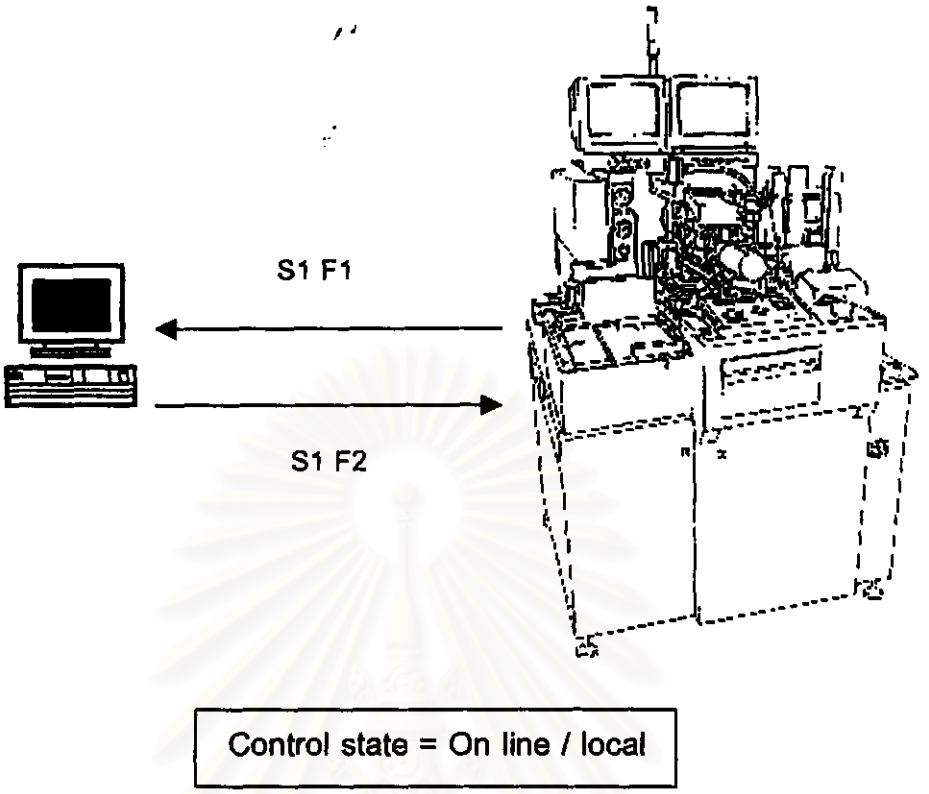

Figure 5.8: The S1F1 / F2 transaction

The control state on the main window of the equipment will change to be "**On line / local**" if an S1F2 is accepted by the equipment (ACK is received). This indicates that the host communication interface between the equipment and host is possible. Hence, host computer is able to monitor the machine processing state and detect the machine errors.

5.3.4 Machine state monitoring

The **"State detection"** command is selected in order to start the machine state monitoring. There are 3 processing states of the die attach machine, e.g., Ready state **(Idle)**, Not ready state **(Down)**, and Executing state **(Utilised)**. Whenever the machine state transition occurs, a machine transition report is sent by the equipment to the host computer through the S6F11 message. If this message is detected and accepted by the host, it will be interpreted, and host then replies S6F12 message to the equipment as shown in the following figure.

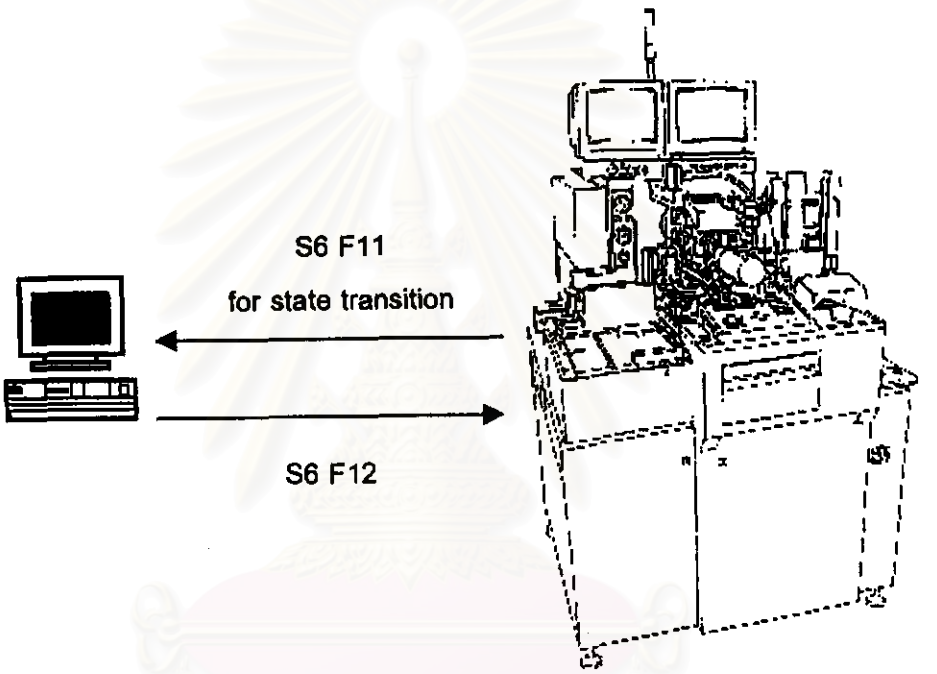

Figure 5.9: Machine state transition report sent from the equipment

The current machine state shall be displayed on the monitor of the host computer and recorded on a specific file. Figure 5.10 illustrates the machine state that is displayed on the host computer when processing state transition occurs.

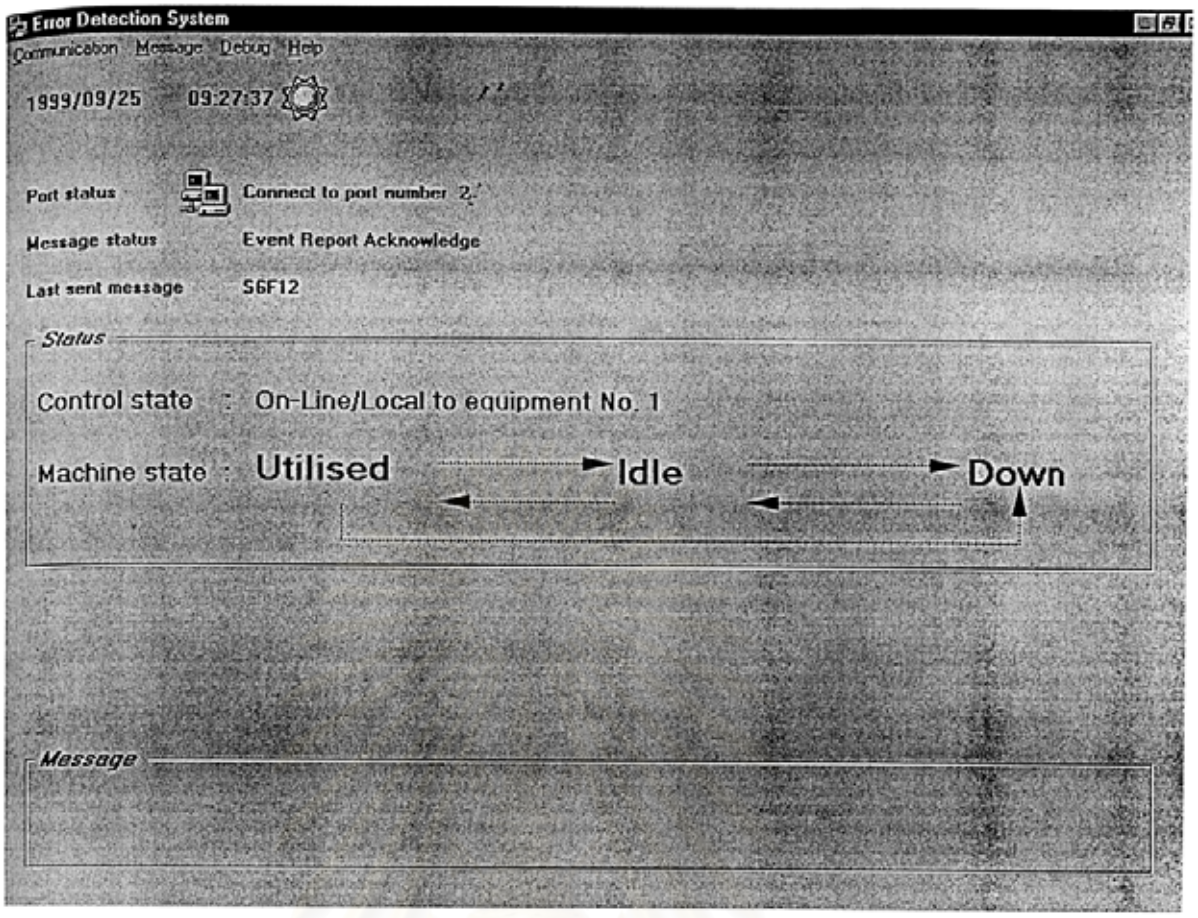

Figure 5.10: Machine state change for each processing state transition.

5.3.5 Machine error detection

There are 8 categories of errors and abnormal situations on the ESEC die attach machine model 2007. This is defined by the manufacturer, ESEC SA, based on the physical safety limitation. These machine errors and abnormal situations are as below:

1) **Material warning** – a piece of equipment is going to run out of material.
2) **Material stop error** – a piece of equipment detected the end of material.
3) **Equipment warning** – equipment detected an un-awaited situation.
4) **Equipment stop error** – an abnormal situation was detected which requires operator intervention.
5) **Parameter control warning** – a parameter is outside its normal limits.
6) **Parameter stop error** – a parameter is outside reasonable limits.
7) **Hardware system error** – a fatal error was detected on the hardware.
8) **Software system error** – a fatal error was detected in the software.

When the machine error occurs and is detected, the machine stops immediately in order to prevent damage on the product and then transit the processing state from "EXECUTING" state to "NOT READY" state. An error report with code of error category and specific error type are then sent by the equipment through S6F11/F12 transaction (refer to section 4.4.2.5 on Alarm management and exception reporting) as shown in the below figure.

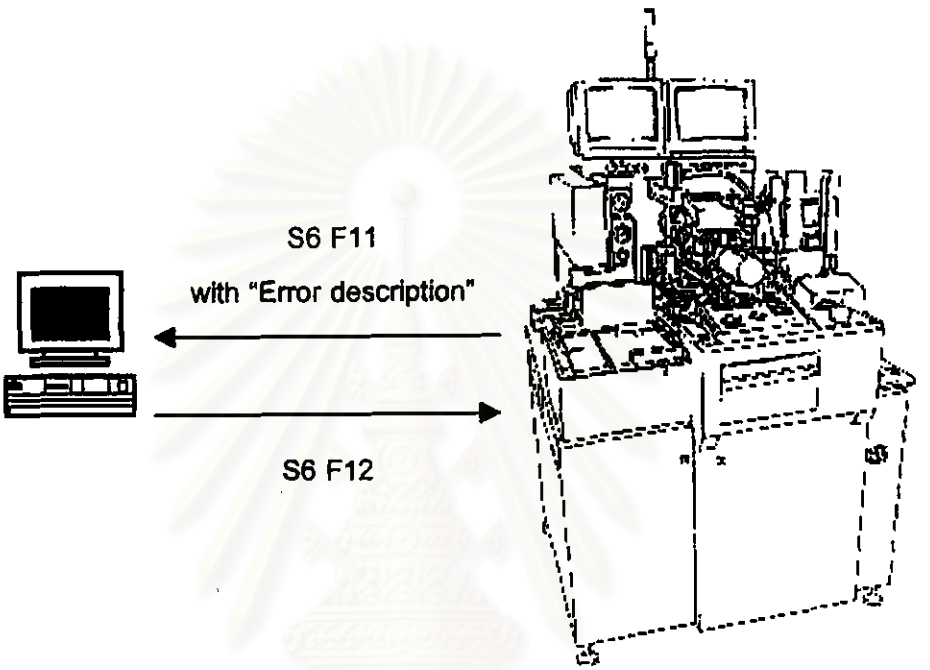

Figure 5.11: Error message is sent from the equipment

Based on this concept, the error detection system frequently waits for an error message from the equipment. Whenever a machine error occurs, the equipment sends an error message with details of error to the host computer. This message is received and then interpreted for the meaning of error such as error category and error type. After that, host computer display this information on its monitor and then record onto a specific file.

Hence, all machine errors and abnormal situations are detected and recorded by the host computer. This information can be used for further analysis. Figure 5.12 illustrates the display of equipment error on the host's monitor when an error occurs on the machine.

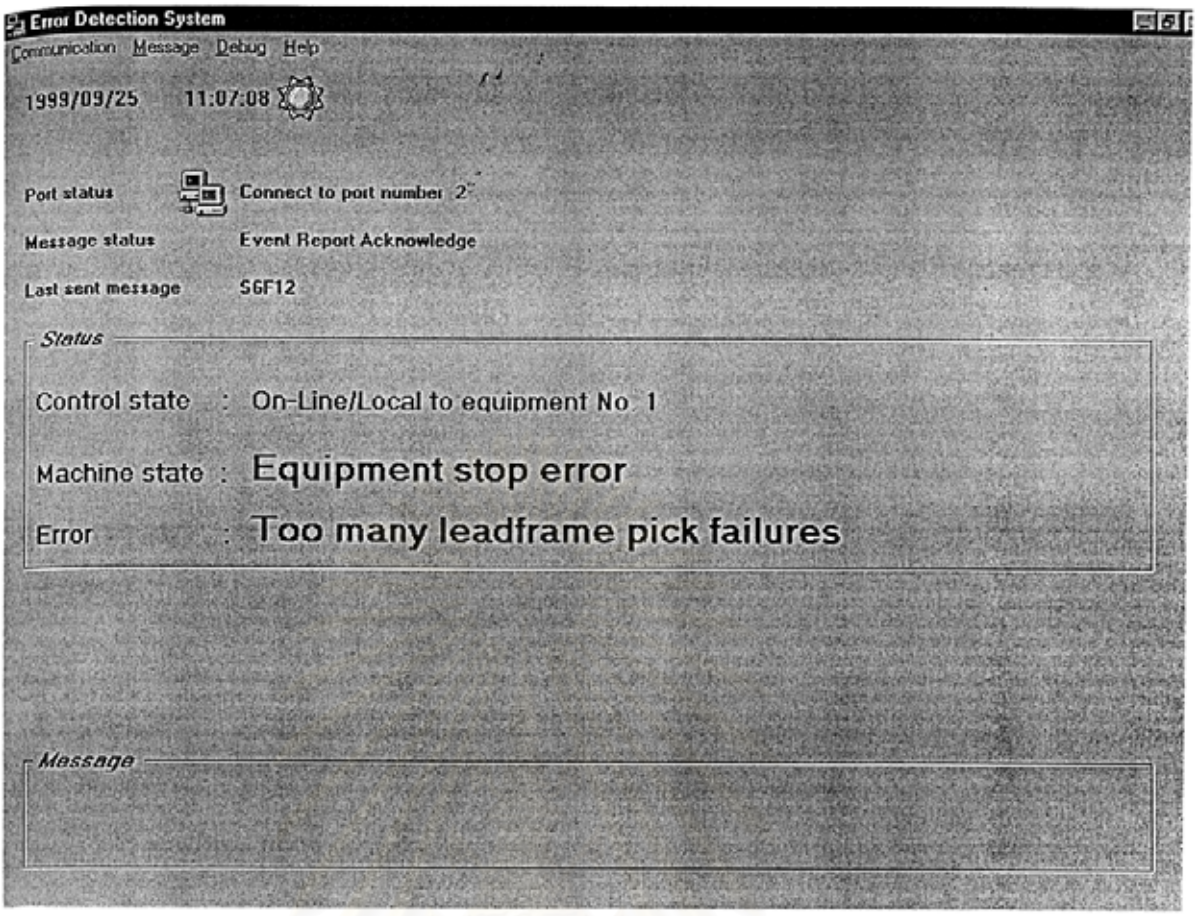

Figure 5.12: Equipment error is displayed on the host's monitor.

It is not only the machine state monitoring and error detection developed but also some capabilities are added into this system. It includes material movement monitoring and status value requisition as described in the following sections.

5.3.6 Material movement monitoring

According to the material movement capability, whenever the material such as magazine is moved from a location to another location, an event report is sent from the equipment using S6F11/F12 transaction as shown in the Figure 5.13 (refer to section 4.4.2.6 on Material movement). This is to provide the activities of the machine during its operation. However, the processing state does not transit.

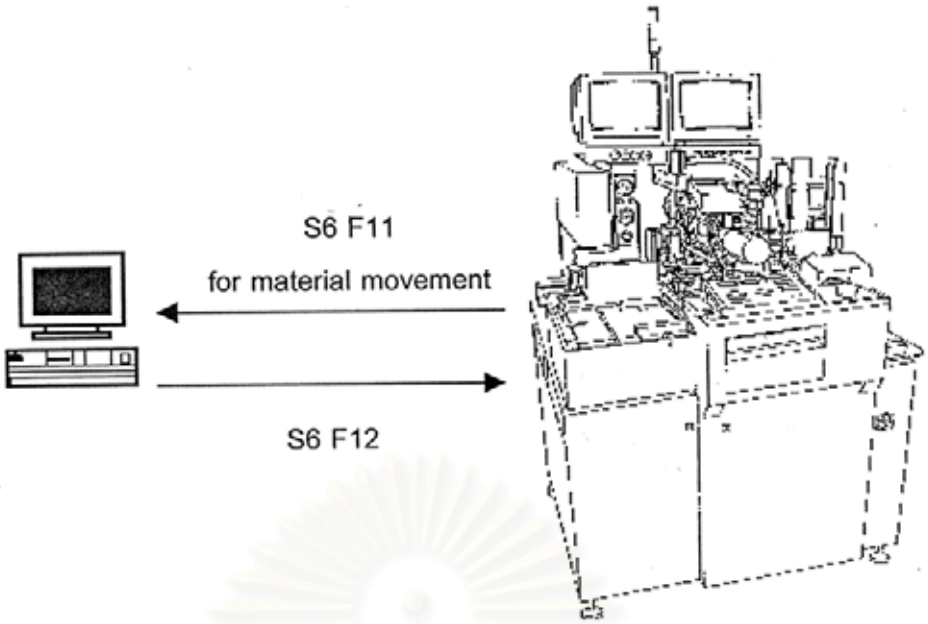

Figure 5.13: Message of material movement sent from the equipment

For example, when the magazine is move from Output carrier to Post-output buffer, an S6F11 with detail of movement will be sent from the equipment. The program must interpret this code and then display on the monitor as shown in the figure 5.14. An S6F12 is also sent to the equipment in order to acknowledge this message.

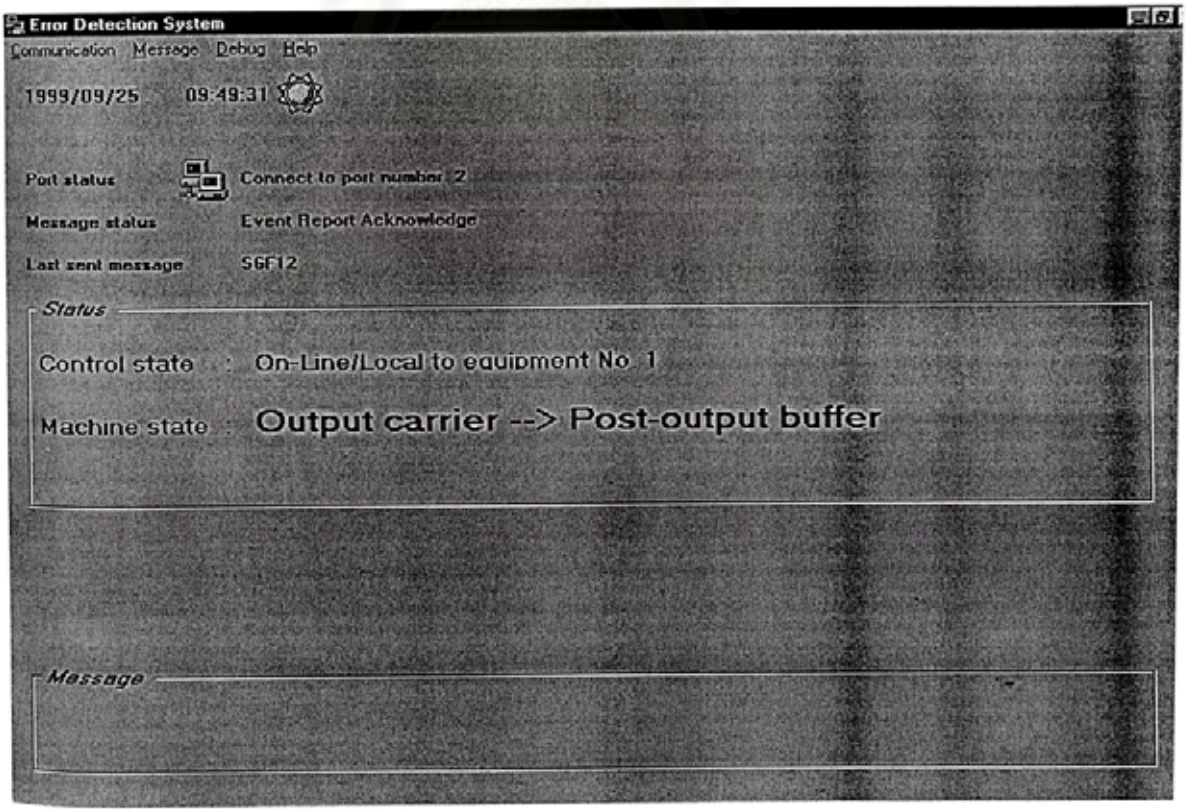

Figure 5.14: Material movement during machine operation.

5.3.7 Status variable value requisition

The status variable value is requested from the host through S1F3 message. The selected status variable identifier (SVID) is provided to the equipment and then wait for the reply message (S1F4) from the equipment. The reply message contains the value of selected status variable so that the program must approach this value and display on the monitor. The message transaction can be illustrated as below figure.

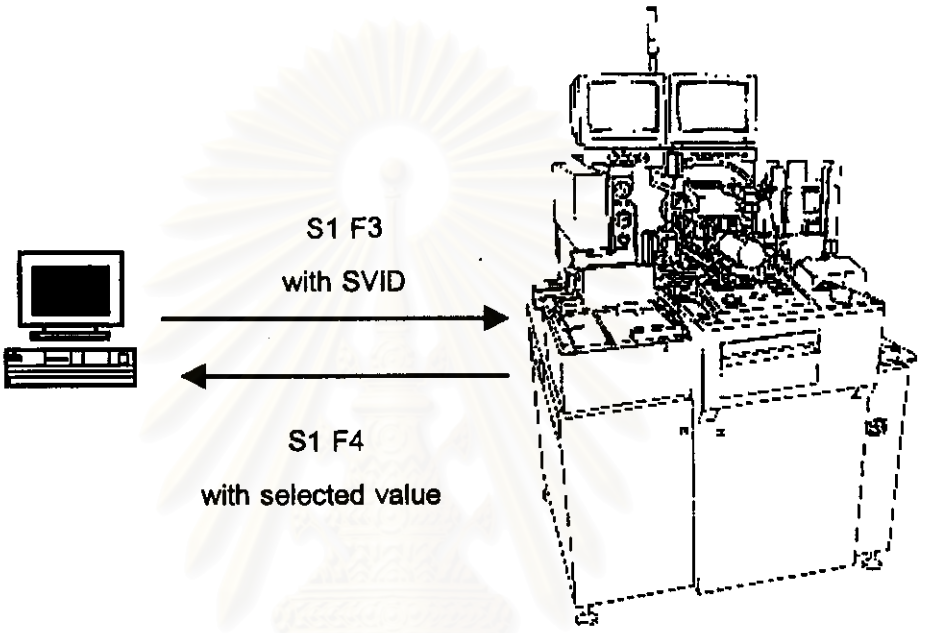

Figure 5.15: Host request the status value from the equipment

The software is initially designed to query three status variable, i.e., Communication state, Control state, and Net uph. The menu of selection is shown in the figure 5.16

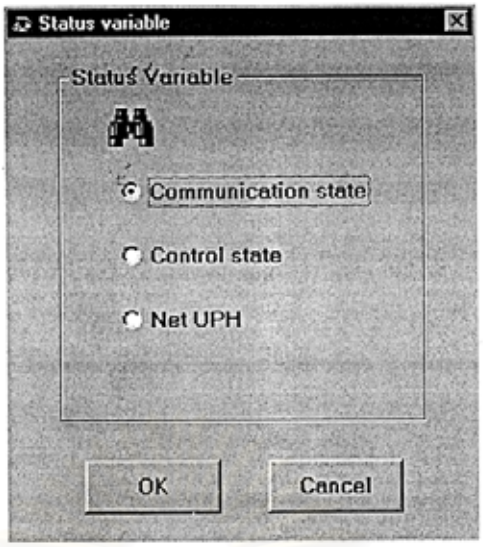

Figure 5.16: Status variable selection

The reply message of S1F4 with the status value will be sent from the equipment. The program gets this value, interprets and then displays on the monitor. The Figure 5.17 illustrates the information of status variables after interpreted by the program.

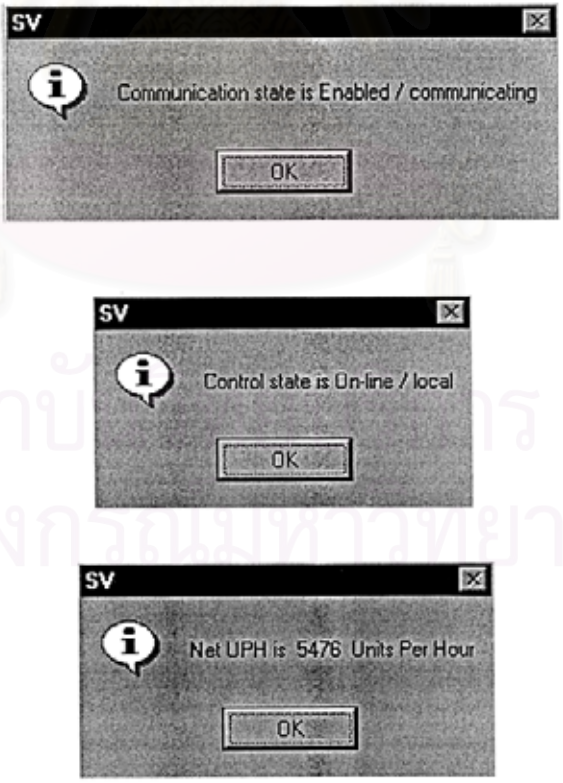

Figure 5.17: Information of selected status variable.

5.4 Recording

Almost all activities since program starting such as machine state transition, machine error, material movement are recorded in an electronic text file. Therefore, the information of machine activities can be analysed. This file can be easily used for further analysis via other software i.e. Microsoft excel, Microsoft access, etc. The following figure is example of information that is recorded in the file.

Date	Time	Duration	State	Error
1999/08/11	14:14:44	00:00:04	Start	
1999/08/11	14:14:48	00:00:30	Connect to port number 2	
1999/08/11	14:15:18	00:00:05	On-Line/Local to equipment No. 8	
1999/08/11	14:15:23	00:00:35	Utilised	
1999/08/11	14:15:58	00:00:02	Idle	
1999/08/11	14:16:00	00:00:48	Utilised	
1999/08/11	14:16:48	00:00:04	Idle	
1999/08/11	14:16:52	00:34:03	Utilised	
1999/08/11	14:36:25	00:00:00	Output carrier --> Post-output buffer	
1999/08/11	14:36:34	00:00:00	Post-Input buffer --> Output carrier	
1999/08/11	14:50:55	00:00:04	Idle	
1999/08/11	14:50:59	00:04:03	Utilised	
1999/08/11	14:54:59	00:00:00	Equipment stop error	Dispense reference hole not found
1999/08/11	14:55:02	00:00:09	Down	
1999/08/11	14:55:11	00:00:02	Idle	
1999/08/11	14:55:13	Exit		

Figure 5.18: Example of machine activities on the file.

5.5 Implementation

An ESEC die attach machine model 2007 is interfaced to a host computer and then launch the program of die attach machine error detection system. Since the communications have been established and data is on line, the status of machine can be monitored in real time while every equipment errors are detected by the host computer. All state transition, equipment errors and machine activities have been recorded into a file. This file will be used for analysis and evaluation. The die attach error detection system will be evaluated in Chapter 6.