2.2 MODULE ADDRESSING

I/O modules, processor module land power supply are siutated in a chassis of the PLC. The I/O modules are actually placed in an I/O rack. Each I/O module in turn consists of I/O groups made up of a set of input and output terminals. These input and output terminals are used to connect real world input and output devices with the PLC.

The location of an input/output terminal, within a module group, within a rack will determine, device address. Each input and output device must have an unique address. The addressing format used by Allen-Bradley PLCs is shown figure 2.8. This format consists of a five-level hierarchy for addressing :

- **A File Type** indicates an input or output module (I-Input, O-Output).
- **A File No.** indicates particular type of I/O module.
- **A Rack No.** indicates the rack on which the module is mounted.
- **A Group** is a set of terminals within a rack. Typically, there are eight groups (0-7) in a rack.
- **Terminal No.** It is the actual terminal number in the group to which I/O device is connected.

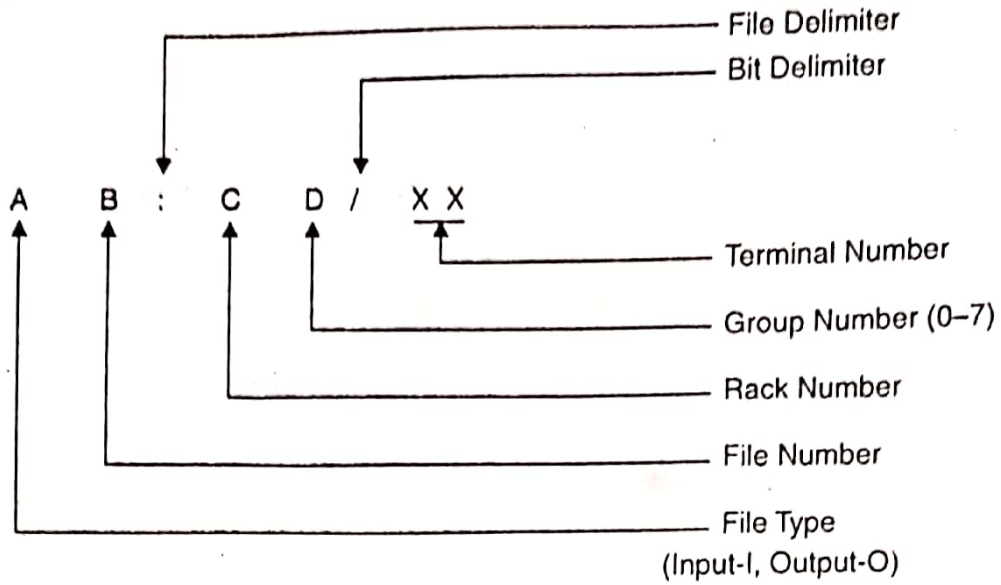


Fig. 2.8 Allen-Bradley Addressing Format

2.3 PLC REGISTERS

PLC CPU has two types of registers : **internal registers and external registers. The internal registers** are the registers of the microprocessor/ microcontroller and are not directly accessible by the user. Width and number of these registers depends upon the microprocessor used and helps the processor to carry out the operations. In addition to these internal registers, the CPU's RAM also has slots (storage memory area) that are used to hold variable informations. These locations are called **external registers and are normally 16-bit wide.** These registers are usually designated by using prefixes followed by numbers. The prefixes indicates the function of the registers like timer, counter, status, integer register etc. Functions and addresses for the external registers of a PLC are obtained from user manual of the PLC.

2.4 PLC OPERATION

When the PLC is powered ON, the processor does an internal diagnostic checks for memory, I/O devices etc., before the actual start of execution of user program. During PLC operation on user program, the CPU reads the Input terminal status, executes the user ladder program stored in system memory and outputs the data to output devices and then repeats the same process again and again. This processing technique is called **scanning. PLC Scanning** operation is made up of mainly three parts :

- **Input scan**
- **Program scan**

- **Output scan**

The total time for one complete program scan is sum of input, program and output scan times. This time depends upon the speed of the processor used and the length of the program and is called **Response Time** or **Scan Time.**

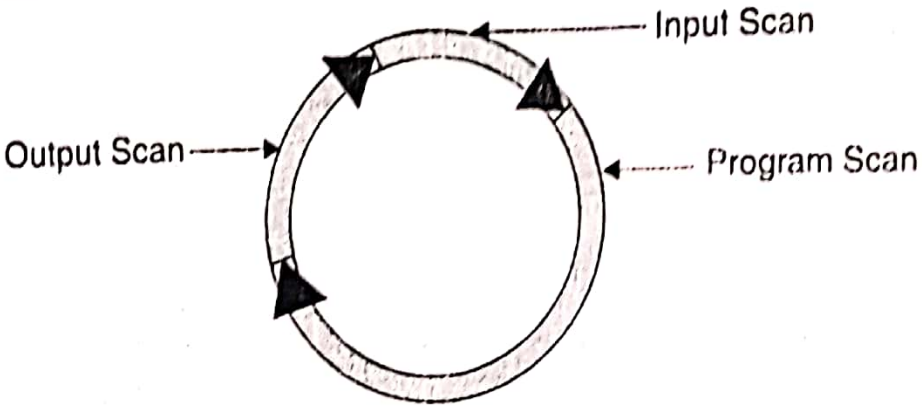


Fig. 2.9 : PLC Scan Cycle

Thus scan time is the time taken by PLC to get from one input scan to next input scan. The speed at which a PLC scan is a called **scan rate.**

2.4.1 Input Scan

The PLC scanning operation starts with Input scan. During the input scan, input terminals are read and the Input Image status table is updated accordingly.

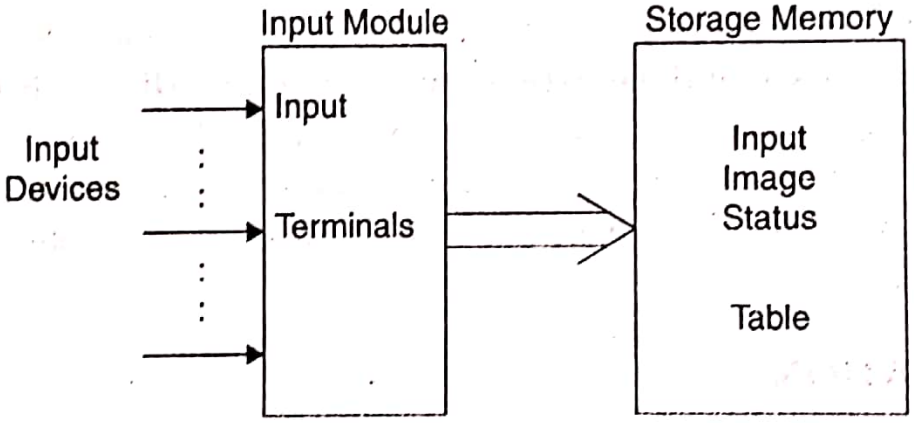


Fig. 2.10 : Input Scan

2.4.2 Program Scan

After input scan, program scan is executed. During program scan, data in the input status table is used for user program. Program instructions are executed in sequence i.e. from left to right across each rung and rungs from top to bottom. According to the results of instructions, output status table is updated after each rung. However, these output status table contents are not transferred to output terminals.

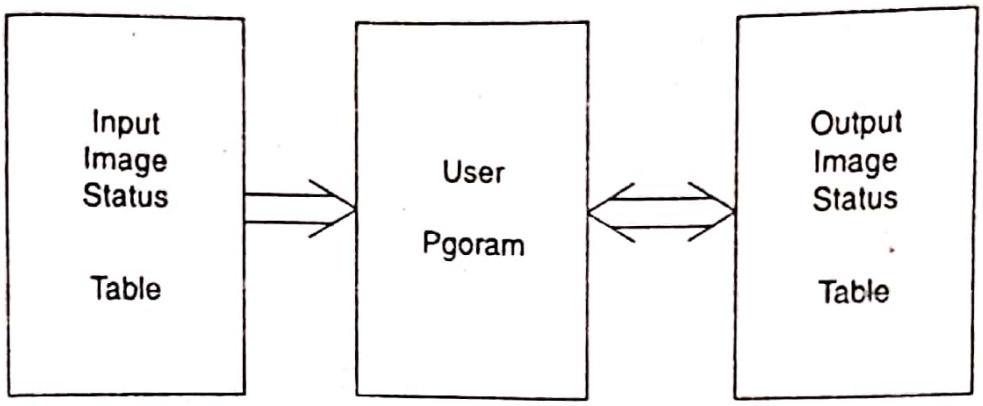


Fig. 2.11 : Program Scan

2.4.3 Output Scan

After completion of program scan, output scan is executed. During output scan, data stored in output status table is transferred to output terminals. After completion of output scan, input scan is again started. But before going back to input scan, CPU communicates with the programmer and network devices (This step is called **communication cycle)** and then updates the internal time base and status files (called **processor overhead cycle).**

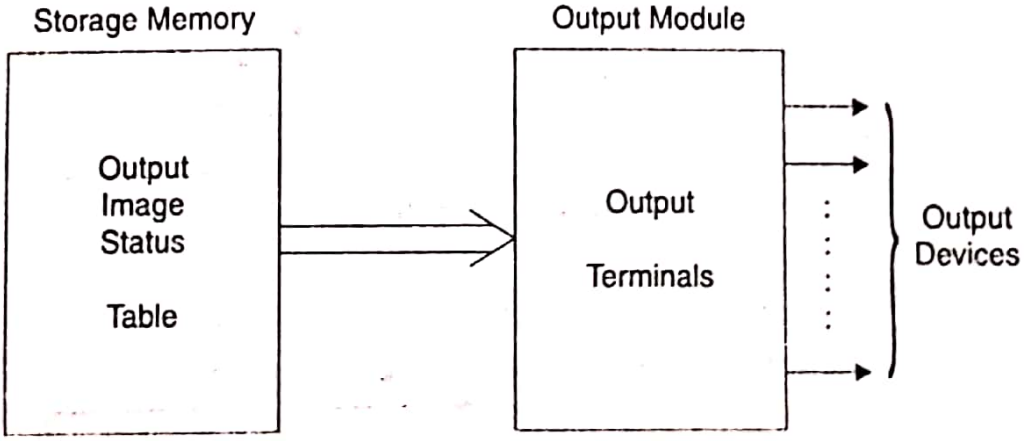


Fig. 2.12 : Output Scan

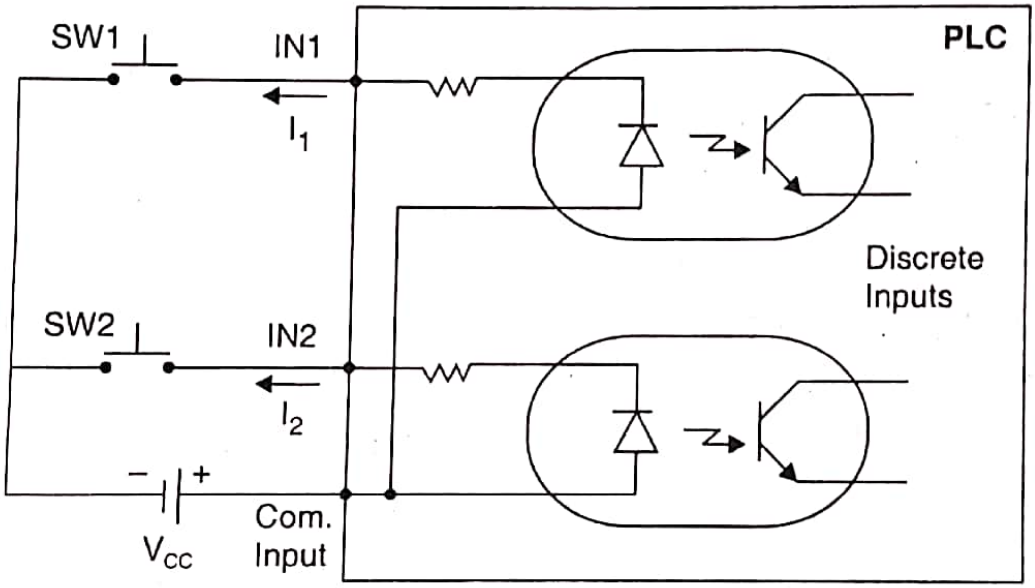
Note : It is important to note that input scan, output scan and program scan are separate, independent functions. Any change in the status of input devices during the program or output scan are not recognized untill the next input scan. Similarly, data changes in the output status table are not transferred to the output terminals during input and program scan. This transfer takes place only during output scan. Some PLCs has special commands for immediate update of I/O during program scan.

2.5 SOURCING AND SINKING INPUTS/OUTPUTS

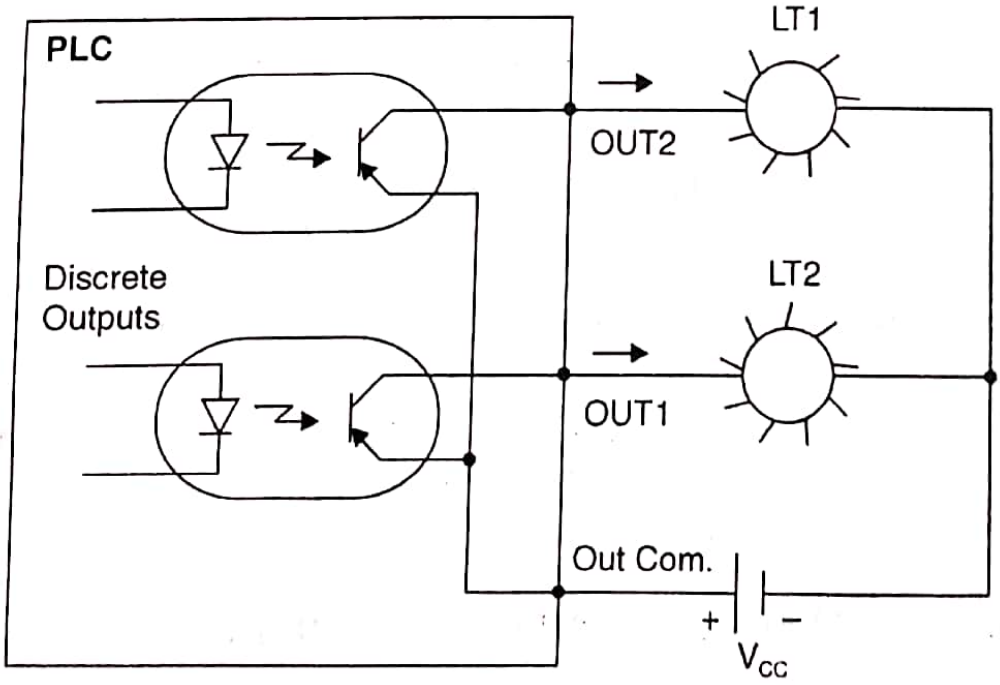
Input and output devices can be connected to I/O modules in two manners : Sinking and Sourcing.

A **Sourcing connection** method is one in which current is flowing out of the device when it is switched ON. A **sourcing input** will be ON when current is flowing out of the input terminal and a **sourcing output** will be ON when current flows out of the output terminals. In sourcing connection, common terminal is connected to Vcc (+ve).

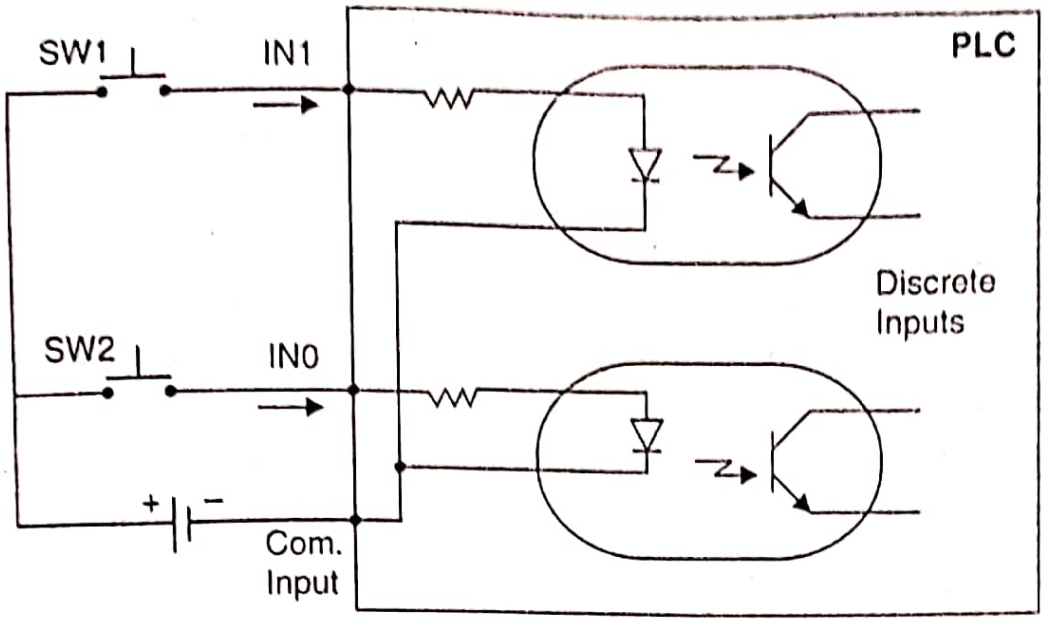
A **Sinking connection** method is one in which current is flowing into the device when it is switched ON. A **sinking input** will be ON when current is flowing into the input terminal, and a **sinking output,** when ON, will have current flowing into the output terminal.



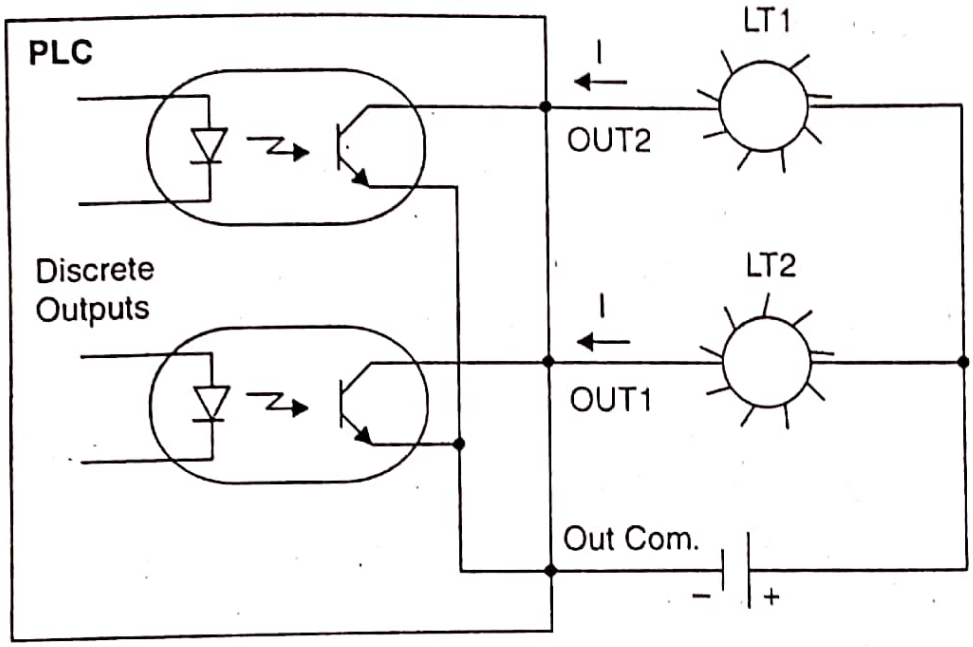
(a) Sourcing PLC Input



(b) Sourcing PLC Output



(c) Sinking PLC Input



(d) Sinking PLC Output

Fig. 2.13 Sourcing/Sinking PLC Input/Output