AUTOMATION OF FUEL DISPENSER

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Declaration

I declare that the contents of this thesis represents my own work and the opinions contained here are my own. It has not been submitted before for any examination at this or any other institute.

N.G.Louw

(Signature)

ACKNOWLEDGMENTS.

I wish to thank my colleagues in the Research and Development Centre of Telkom S.A., with whom many helpful discussions were held.

Abstract

Malpractices, due to inefficient flow control at fuel dispensers, especially those owned by private companies, led to the idea of an automated fuel dispenser. Such a dispenser would be activated by means of an intelligent card, containing information such as the vehicle registration number, driver's name, fuel tank capacity, supplier name, last recorded odometer reading and the driver's personal I.D. number (PIN). Access to the system is obtained by keying in a PIN code. The amount of fuel dispensed is monitored and could be used together with information from the card, to calculate fuel consumption data for every vehicle. The information accumulated in the memory of the system can be downloaded via a modem link to a central control point, eliminating the use of logbooks and saving companies a lot of time and money.

Opsomming

Onvoldoende toesig oor brandstof verbruik, veral by privaat maatskappye, het tot die idee van 'n geoutomatiseerde brandstof verspreider gelei. Sodanige verspreider word geaktiveer deur middel van 'n intelligente kaart wat die volgende inligting bevat: voertuig registrasie nommer, bestuurder se naam, brandstof tenk kapasiteit, verskaffer se naam, jongste odometer lesing en die bestuurder se persoonlike identifikasie nommer (PIN).

Toegang tot die stelsel word verkry deur 'n PIN kode in te sleutel. Die hoeveelheid brandstof verskaf deur die verspreider word gemoniteer, en kan tesame met die inligting op die intelligente kaart gebruik word om die brandstof verbruik van elke voertuig te bereken. Die informasie word gestoor in die geheue van die stelsel, en kan met behulp van 'n modem verbinding oorgestuur word na 'n sentrale beheer punt. Die gebruik van logboeke deur maatskappye word uitgeskakel en lei tot 'n aansienlike besparing in tyd en uitgawes.

CONTENTS

1. INTRODUCTION.

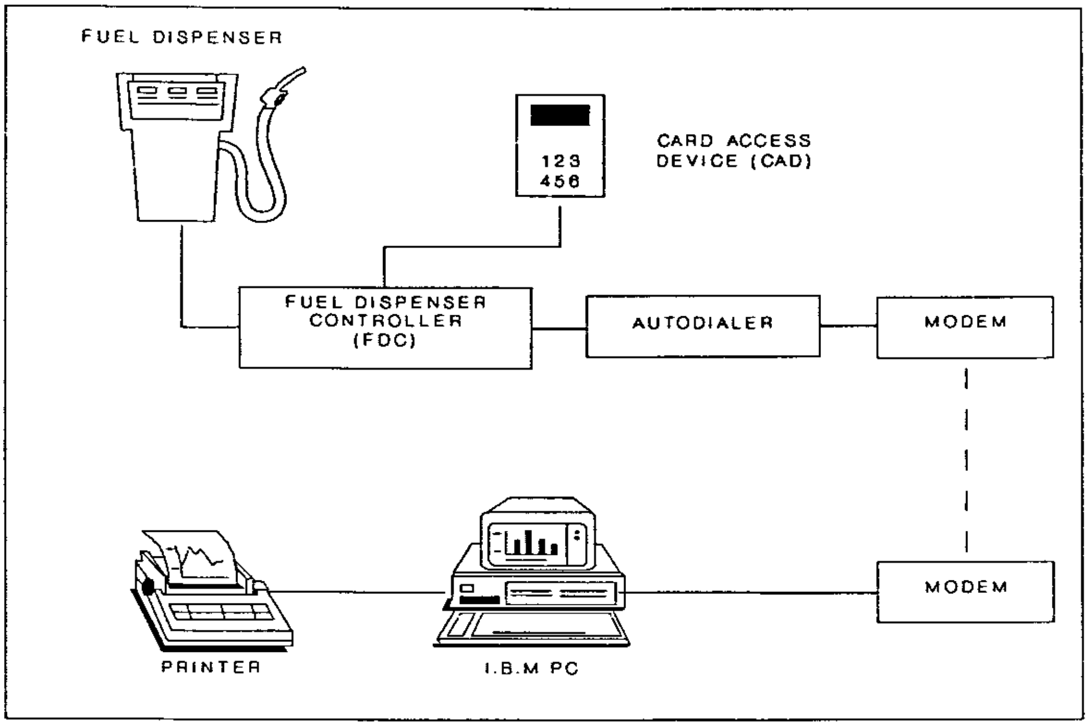

Fig.1.

1.1. Fuel Dispenser System.

The overall layout of the system is shown in Fig.1. above. The system is comprised of a FDC which contains a microprocessor (uP) with program memory (software controlling the uP) and RANDOM ACCESS MEMORY (RAM) from where all the information to be processed can be stored or retrieved.

The FDC is linked to a card access device (CAD) which communicates with the uP via a serial data link. The FDC is also linked to a modem for downloading the information accumulated in the RAM to a computer. The computer will be situated at a remote site and a printer will generate a printout at the computer operator's request. A sensor connected to the fuel dispenser records the fuel flow and the amount dispensed is registered in the uP.

1.2. Fuel Dispenser Controller (FDC).

This is the heart of the system. It communicates with the

outside world via the cardreader from which it receives information instructing it to activate the dispenser.
It is also responsible for calculating the fuel consumption of the vehicle serviced at that time. The FDC will automatically detect when the RAM is full and will instruct the modem to download the necessary information. When a power failure is detected the FDC will indicate a "POWER FAILURE AT REMOTE SITE" alarm on the remote computer.

1.3. Card Access Device (CAD).

Access to the fuel dispensing system is controlled by the CAD which consists of a microprocessor-controlled 16 key alphanu-meric keypad and a liquid crystal display (two lines of 16 alphanumeric characters).
An asynchronous data link that supports speeds from 1200 to 9600 bauds, provides communication between the CAD and FDC.

A rechargeable battery supplies power to the device in the event of a power failure. It also enables the CAD to be used as a portable device. In this application the CAD is used as a dedicated device.

The programming language needed to program the CAD for the application is identical to the language used in the FDC, viz INTEL 8051 FAMILY machine code language. This ensures full compatibility between the software utilized in both devices (CAD and FDC) and simplifies the development of the system software.

1.4. BULL CP8 Microcard (Smartcard).

The BULL CP8 card consists of a single active component comprising of a SELF-PROGRAMMABLE ONE CHIP MICROCOMPUTER (SPOM) which combines not only program and data memories but also intelligent functions handled by the CPU whose activity is totally determined by a mask.

A schematical layout of the CP8 Microcard can be seen below.

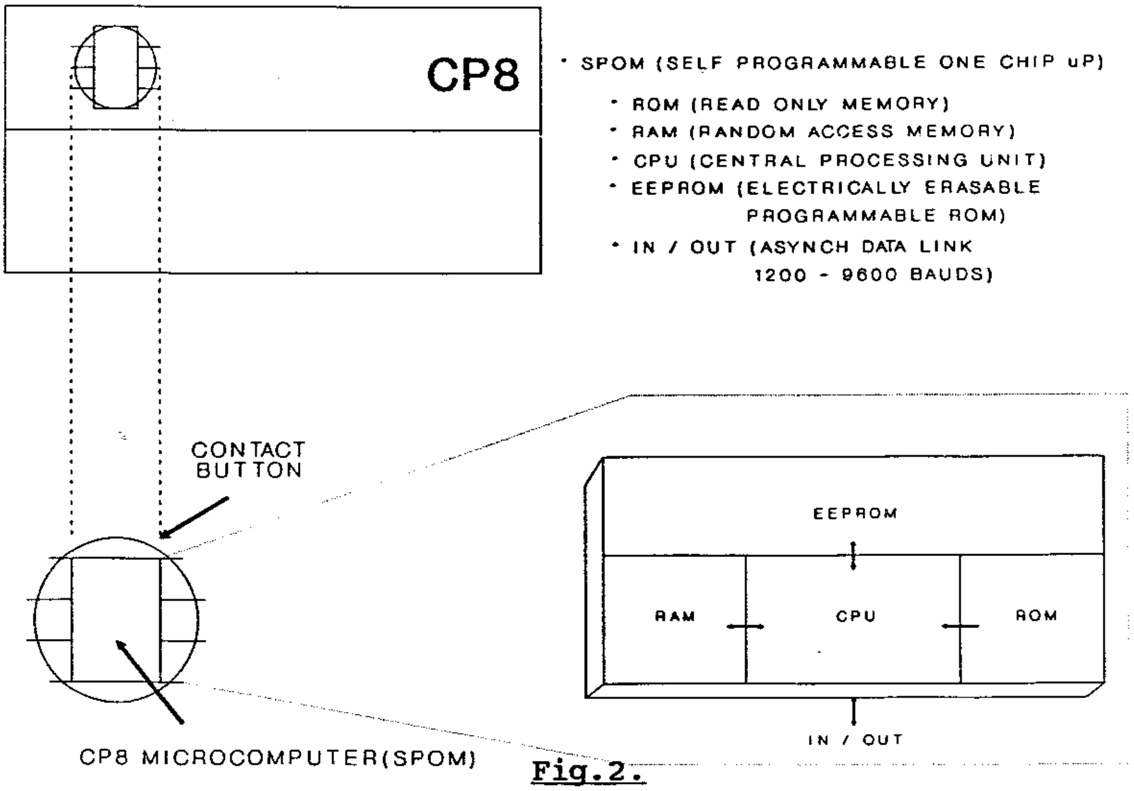
CP8
• SPOM (SELF PROGRAMMABLE ONE CHIP uP)
• ROM (READ ONLY MEMORY)
• RAM (RANDOM ACCESS MEMORY)
• CPU (CENTRAL PROCESSING UNIT)
• EEPROM (ELECTRICALLY ERASABLE PROGRAMMABLE ROM)
• IN / OUT (ASYNCH DATA LINK 1200 - 9600 BAUDS)
CONTACT BUTTON
EEPROM
RAM
CPU
ROM
IN / OUT
CP8 MICROCOMPUTER(SPOM)

Fig.2.

The mask is a set of programs that are etched, at the time of manufacture, into the SPOM's READ ONLY MEMORY (ROM).

As the name Smartcard indicates, the card is intelligent and is able to execute different functions such as reading or writing data in memory, performing algorithmic calculations and communicating with external devices. These operations are executed and controlled by the CPU.

Furthermore, it can store and manage data reliably and in complete security, identify the card holder, validate the card - ensuring that it is authorized for use in a given system, certify a transaction or a message to guarantee data integrity and generate cyphering keys.

In this particular application the storing and updating (EEPROM) feature of the Microcard was used to good effect as it was used to store all the information of a vehicle and its driver. To ensure complete security the user of the system has his or her own password which permits access to the system provided that the password and the card are valid.

2. OBJECTIVE.

Companies using more than 15000 litres of fuel per month, over three successive months are entitled to their own fuel dispensers (pumps). This implies that the company presently benefits in a true reduction of 2 cents for every litre pumped.

The idea of an automated fuel dispenser system with fuel flow monitoring and access control was proposed to the School of Electrical Engineering at the Cape Technikon, by the ENERGY RESEARCH COUNCIL, to curb alleged malpractices.

A fuel dispenser controller (FDC) with the following features is required:

i) The dispenser would be activated by a card access system which provided storing and managing of data reliably and in complete security.

ii) The driver would be required to type in a personal identification code as well as the odometer reading to activate the pump.

iii) The dispenser must be equipped with a sensor measuring the fuel flow and together with the old and present odometer readings, work out the fuel consumption of the vehicle.

iv) When linked to a central computer via a modem link the fuel dispenser controller (FDC) must be able to download all the information associated with a particular vehicle.

Since current fuel logging and usage systems based on log books are labour intensive, time consuming and open to abuse, the objective of this project is to develop a FDC system that is efficient and cost effective and that will provide security against misuse.

3. HARDWARE IMPLEMENTATION.

On having decided to use the CP8 Microcard and CAD for the access control part a choice had to be made for a suitable microprocessor (uP) for the fuel dispenser controller (FDC). The INTEL 80C31BH (ROMLESS version) was chosen for this purpose. The 80C31BH ensures full software compatibility with the microprocessor used in the CAD. By using CMOS technology the uP provides a feature called the IDLE MODE which enables the microprocessor to go into a low power consumption mode in order to preserve the backup battery during a power failure.

The decision to use the ROMLESS version is justified by the fact that greater flexibility is given to the system, for expansion or modification, by simply changing the program in the external EPROM. The full duplex UART of the uP is used for communication with the CAD.

3.1. Central Processing Unit. (CPU - 80C31BH)

The features of the 80C31BH core are:

* 8-bit CPU
* Boolean processing capabilities
* 64K Program Memory address space
* 64K Data Memory address space
* 128 bytes on-chip RAM
* Four Input/Output ports
* Two 16-bit timer/counters
* Full duplex UART
* Interrupt structure (INT0,INT1)
* On-chip clock oscillator

The term 8-bit CPU refers to the 8-bit Data bus being used by the 80C31BH. Controllers often deal with bits, not bytes: in the real world, switch contacts can only open or close, indicators should be either lit or dark, motors are either turned on or off and so forth. For such control situations the 80C31BH is ideal as it supports one-bit or boolean processing operations. This incorporates special features such as the direct manipulation and testing of individual bits and the use of single-bit variables for performing logical and arithmetic functions.

3.1.1. Address/Data bus.

The CPU has a 16-bit address bus consisting of an 8-bit multiplexed address/data bus (AD0 - AD7) representing the lower half of the 16-bit address bus. It also acts as an 8-bit data bus during read/write operations.

Addresses A8 - A15 provide the upper half of the 16-bit address bus. The 16-bit address bus can be seen in Appendix D-1, where P0.0 to P0.7 represents AD0 - AD7 and P2.0 to P2.7 represents A8 -A15.

The multiplexed address/data bus (AD0 - AD7) is connected to an address latch (74LS373) in order to latch the address presently on the bus thus preventing it from being overwritten by a byte of data since this bus is time multiplexed between address and data bytes. The address "stored" in the latch is gated on to the address bus by the Address Latch Enable (ALE) (U3 pin 30 - Appendix D-2) signal under CPU control. Addresses A8 - A15 are connected directly to the appropriate pins of the various I.C.'s that require addressing.

The 16-bit address bus enables the CPU to address up to 64Kbytes of program or data memory respectively.

3.1.2. Interrupts.

The CPU supports 2 external interrupts (INT0 & INT1), 2 timer interrupts (TIMER 0 & TIMER 1) and the serial port interrupt (TI for TXD and RI for RXD).

In this application INTO is connected to the power failure circuit to indicate a power failure to the CPU. (U3 Pin 12-Appendix D-2).

The determination of fuel flow was achieved by connecting INT1 to the fuel dispenser. (U3 Pin 13 - Appendix D-2)

Using TIMER 1 in the 8-bit auto-reload mode a baud rate of 1200 to 19200 bauds can be obtained depending on the crystal used and the reload value in TIMER 1.

3.1.3. RS 232 serial port.

The serial port is a full duplex port. It is used in the 8-bit UART mode enabling it to vary the baud rate according to the programmers needs.

The serial port provides a link between the FDC and the CAD for exchanging control signals and valuable information. (U3 Pins 10 & 11 - Appendix D-2)

3.1.4. Input/Output ports.

All four ports in the 80C31BH are bidirectional. Each consists of a latch (Special Function Registers (SFR's) P0 through P3), an output driver and an input buffer.

The output drivers of Ports 0 and 2 and the input buffers of Port 0 are used for accessing external memory. In this application, Port 0 outputs the low byte of the external memory address, time-multiplexed with the byte being written or read. Port 2 outputs the high byte of the external memory address when the address is 16 bits wide. Otherwise the Port 2 pins continue to emit the P2 SFR content.

All the Port 3 pins are multifunctional. They are not only port pins, but also serve the following special functions:-

* P3.0	RXD (serial input port)
* P3.1	TXD (serial output port)
* P3.2	$\overline{\text{INT0}}$ (external interrupt)
* P3.3	$\overline{\text{INT1}}$ (external interrupt)
* P3.4	T0 (Timer/Counter 0 external input)
* P3.5	T1 (Timer/Counter 1 external input)
* P3.6	$\overline{\text{WR}}$ (external data memory write strobe)
* P3.7	$\overline{\text{RD}}$ (external data memory read strobe)

In this application the special function features of Port 3 were used.
The pins of Port 1 were used to control the following:-

* P1.0	Enabling fuel dispenser.
* P1.1	Retrieving sensor.
* P1.2	Autodialer.
* P1.3	Connect modem to line.
* P1.4 - P1.7	Unused.

3.2. Program Memory. (EPROM - 27C64)

For the program memory the UV erasable 27C64 (8Kx8) EPROM chip was used. The memory is organized as 8192 words of 8 bits each. The chip employs advanced CHMOS circuitry for systems requiring low power, high performance speeds and immunity to noise.

To access the program burned into the EPROM, the $\overline{EA}$/Vpp pin on the CPU must be taken to ground (Vss) to indicate to the CPU that an external program memory fetch is required.

Program Store Enable (PSEN) acts as the read strobe to external program memory. (U3 pin 29 - Appendix D-2)

In Appendix D-3 it can be seen that pins 1 & 27 of U5 are tied to +5V because these pins, viz VPP and PGM respectively are only used during the programming of the EPROM.

3.3. Data Memory. (RAM - 62C64)

A 62C64 (8Kx8) RAM chip provided the external data memory. The memory structure of this chip is also organized as 8192 words of 8 bits each.

The information accumulated from the FDC, after each vehicle has been refueled, consists of 82 bytes representing the data for: litres pumped, fuel consumption, etc. Given the capacity of the 62C64 a total of 99 vehicle's information can be stored, leaving 74 bytes spare:

$$8192 / 82 = 99,902$$

Accesses to external data memory are effected by strobing the READ or WRITE pins of the CPU (alternate functions of P3.7 and P3.6).

3.4. Modem interfacing.

Communication between the FDC and the remotely situated computer is very important as all the information needed to maintain an accurate and up to date database must be transmitted to a remote computer for post processing. A considerable amount of time and planning was spent on establishing a reliable and effective communication link whilst keeping overall expenditure to a minimum.

A modem with dial-up facilities was chosen to cater for FDC's that are situated in remote areas and that have a telephone service but can't support a dedicated modem link.

The modem is a Post Office MM 373, 1200 baud asynchronous, with dial-up facilities. Considering that the modem doesn't support an autodialer all the procedures to get the modem on line must be done manually. This problem was overcome by designing an autodialer card and using P1.2 of the CPU to pulse the telephone number to the autodialer.

Interfacing the modem to the CPU was done by using a programmable communication interface chip, the INTEL 8251A universal synchronous asynchronous receiver/transmitter (USART). The 8251A is used as a peripheral device and is programmed by the CPU to operate using virtually any serial data transmission technique ranging from synchronous to asynchronous, full duplex to half duplex and including IBM bi-synch.

3.4.1. Autodialer Card.

By connecting a 39 ohm resistor over the telephone line, a line seizure can be simulated. A double pole double throw (DPDT) 6 Volt relay was used to connect the resistor over the line when instructed to do so by the CPU.

By pulsing P1.2 of the CPU in the following sequence:-33 milliseconds make (logic 1), 66 milliseconds break (logic 0), a single digit being dialed is represented. Therefore to dial the number 9 for example, the sequence described above must be repeated 9 times with an inter digit pause of 800 milliseconds in order for the exchange to recognize it as a valid digit. Delay routines in the software provided the neccessary timing.

3.4.2. RS 232 Interface. (MAX 232)

The RS 232 interface connects the USART to the outside world by, converting the TTL logic levels of the USART to RS 232 levels and vice versa.

RS 232 not only supports DTR, DSR, RTS and CTS handshaking, which is vital in modem communication but a host of other signals as well.
The interface represents a logic 1 by -3 to -20 volts and a logic 0 by 3 to 20 volts. This gives rise to a larger voltage swing, resulting in a better noise immunity and contributes towards eliminating problems encountered in long distance communication.

Two IC's, used by many designers, handle the TTL -RS 232 conversion: the MC 1488 converts from TTL to RS 232 and the MC 1489 from RS232 to TTL.

The MC 1488 driver IC requires a ± 12 volt supply which implies extra power circuitry.

For the purpose of this project, the MAX 232, a +5 volt powered dual RS 232 Transmitter/Receiver, was used. The MAX 232 comprises of three sections: a dual transmitter, a dual receiver, and a ± 5V to ± 10V dual charge pump voltage converter, which supplies the ± 12 volt levels in accordance with the RS 232 specification.
A schematic layout of the MAX 232 chip is shown in Appendix D-4 (U11).

3.4.3. Baud rate generator.

When running from a 2,4576 MHz crystal, the baud rate generator, formed by an oscillator (U9A and U9B) and a 12 stage binary counter (U10), produces an output of 19,2 kHz which is connected to pins 9 & 25 of the USART (see Appendix D-4). The USART can be programmed with a baud rate factor during its initialization.

This factor is a divisor that is applied to both the transmitter and receiver clocks (TXC/RXC) for a specific transmission or reception rate. In this case the USART was programmed with a factor of 16 giving a baud rate of:

19,2 khz / 16 = 1200 baud

The output of U9 is also connected to pin 20 of the USART to provide a clock frequency of 2,4576 MHz.

3.4.4. USART. (8251A)

In a communication environment an interface device such as the USART must convert parallel format system data into serial format for transmission and convert incoming serial format data into parallel system data for reception.

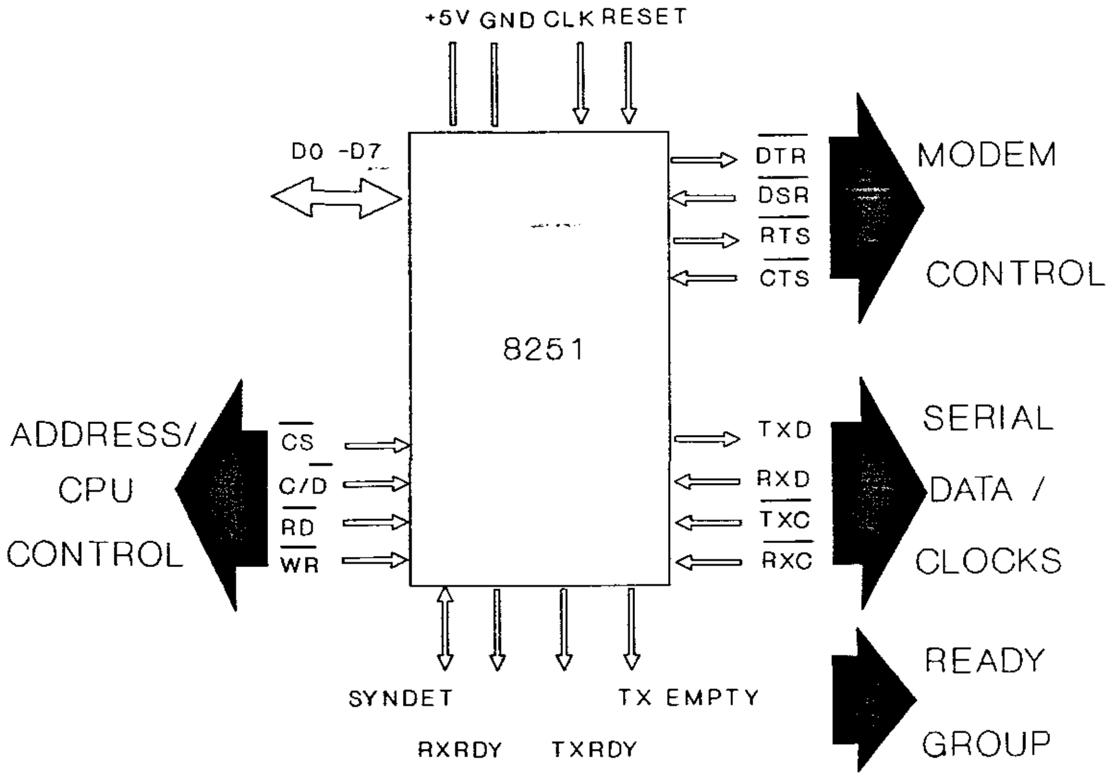

Fig.3.

Fig.3. shows the pinouts of the Intel 8251 USART which is available as a 28-pin dual in line package. The 28 pins consist of eight tristate bidirectional data lines and five groups of four lines. The supply group contains the 5 volt line, ground, external CLK and a hardware reset line which is activated on power-up.

The CPU can also reset the USART by issuing a reset command to it when in the command mode.

The address group contains the $\overline{\text{CS}}$ (chip select) pin which is connected to pin 6 of the address decoder (U2A -74LS139) in order to select the USART when addressed by the CPU. Pins 1-3 of the address decoder are connected to the address bus in such a way that by using the correct address in the memory map the CPU is able to select any of the four chips serviced by the address decoder.

The C/$\overline{\text{D}}$ pin specifies a control port if it is in a logic high state and a data port if in a logic low state. It is connected to pin 2 of the address latch (U1 -74LS373). (See Appendix D-2 for U1 and U2A.)

$\overline{\text{RD}}$ causes the chosen input port to assert its data on D0-D7 and $\overline{\text{WR}}$ loads the appropriate output port with data supplied by D0 -D7.

The serial data group contains the receive data line RXD, the transmit data line TXD, and the receive ($\overline{\text{RXC}}$) and transmit ($\overline{\text{TXC}}$) clock lines. These four lines form the basis of the USART. The baud rate is derived from the $\overline{\text{TXC}}$ or $\overline{\text{RXC}}$ clocks.

Normally the $\overline{\text{TXC}}$ and the $\overline{\text{RXC}}$ can be connected to the same baud rate generator when the USART is transmitting and receiving at the same baud rate. The ready or status group contains three output status lines RXRDY, TXRDY, TXEMPTY and one bidirectional status line, SYNCH DET.

For the purpose of this thesis only the TXRDY status line will be discussed.

This output signals the CPU that the transmitter is ready to accept a data character. The TXRDY output pin can be used as an interrupt to the system, since it is masked by TXEnable; or, for polled operation the CPU can check TXRDY using a status read operation.

TXRDY is automatically reset by the leading edge of $\overline{\text{WR}}$ when a data character is loaded from the CPU.

By writing the software in such a way that the TXRDY pin's status is checked before a character is sent to the USART, it was ensured that synchronization between the CPU running at a clock speed of 11,0592 MHz and the USART running at 2,4576 MHz, was achieved.

The modem control group consists of two outputs, $\overline{\text{DTR}}$ and $\overline{\text{RTS}}$ and two inputs, $\overline{\text{DSR}}$ and $\overline{\text{CTS}}$. The traditional handshaking convention between two communication devices such as the USART and the modem in this case is as follows:

The terminal, (USART), pulls $\overline{\text{DTR}}$ (Data Terminal Ready) and $\overline{\text{RTS}}$ (Request To Send) low, indicating to the data set, the modem in this case, that the terminal is ready and requests permission to send.

The terminal's $\overline{\text{DTR}}$ and $\overline{\text{RTS}}$ are normally connected to the data set's $\overline{\text{DSR}}$ (Data Set Ready) and $\overline{\text{CTS}}$, (Clear To Send) respectively. Correspondingly, the data set pulls its $\overline{\text{DTR}}$ and $\overline{\text{RTS}}$ lines low which are connected to the terminal's $\overline{\text{DSR}}$ and $\overline{\text{CTS}}$ lines.

As the USART is dedicated to the transmission of data only, the $\overline{\text{DTR}}$, $\overline{\text{DSR}}$, $\overline{\text{RTS}}$ and $\overline{\text{CTS}}$ pins of the USART were connected together. This means that the USART always appears ready to the CPU.

The $\overline{\text{RTS}}$ and $\overline{\text{CTS}}$ lines were also extended to the DB 25 pin RS 232 connector for future use, as the idea of connecting the

USART directly to an existing electronic fuel dispenser was kept in mind. It must be remembered that the current program resident in the EPROM must be changed according to the requirements of the application.

3.4.5. <u>MODEM.</u> (STC MM 373)

A 1200 baud full duplex modem with dial-up and auto answer facilities was used. A telephone jack is situated at the back of the modem, while the line lead of the modem has a telephone plug for connection to a Post Office telephone line. A DB 25-pin RS 232 connector provides the communication port to and from the modem.

On the front panel a Voice/Data (VO) button manually connects or disconnects the telephone to the line. When the VO button is in the voice position the telephone is connected to the telephone line and could be used in the normal way to make phone calls. It also provides a link with the control station when installing the fuel dispenser controller (FDC) for the first time and can be used in the event of a modem communication fault.

An auto answer (AA) button enables the modem to automatically connect itself to the telephone line after a preset answer delay. The modem on the receive side was setup for auto answer operation.

At the transmit side the modem was configured with the VO button in the data position permanently. Internally the modem was strapped to transmit DTR, RTS and constant carrier (CD)

signals permanently. This means that when the receive modem goes into the auto answer mode it will react on the DTR, RTS and CD signals by transmitting DSR and CTS signals back to the transmitting modem, thus establishing a data link between the two modems. The transmit modem will now start sending its data until stopped by the FDC.

The autodialer card, described earlier, connects the transmit modem to the telephone line as soon as the call is established.

After transmission of the data, the autodialer disconnects the transmit modem from the telephone line. This causes the receive modem to disconnect itself from the line as it is no longer receiving the carrier signal from the transmit modem and returns to the auto answer mode it was in before communication was established.

The above mentioned procedure is repeated every time data is sent to the remote PC.

3.5. REAL TIME CLOCK. (MM 58274)

The MM 58274 is a bus oriented microprocessor real time clock with the following features: 12 or 24 hours counting, a testable data - changed flag giving easy error free time reading, leap year counter and simplified interrupt control.

A buffered oscillator signal appears on the interrupt output when the device is in test mode. This allows for easy oscillator setting when the device is initially powered up in a system.

The counters are arranged as 4-bit words and can be randomly accessed for time reading and setting. The counters output BCD (binary coded decimal) 4-bit numbers. Any register which has less than 4 bits (e.g., days of week uses only 3 bits) will return a logic 0 on any unused bits. When written to, the unused inputs will be ignored.

Writing a logic 1 to the clock start/stop control bit resets the internal oscillator divider chain and the tenths of seconds counter. Writing a logic 0 will start the clock timing from the nearest second. The time then updates every 100 ms with all counters changing synchronously.

Time changing during a read is detected by testing the data changed bit of the control register after completing a string of clock register reads.

Interrupt delay times of 0,1s,0,5s,1s,5s,10s,30s or 60s can be selected with single or repeated interrupt outputs.

The MM 58274 chip has an on - chip 32,768 kHz crystal controlled oscillator which forms the timekeeping circuit.

4. SOFTWARE.

With the prototype board electronically correct, small test routines, to initialize and set up the various chips, were written to get familiar with each chip's operation. Once all the chips were running according to the software written, the final application program was developed by combining all the separate routines into one large program.

4.1. PROGRAM DEVELOPMENT TOOLS.

The INTEL ICE 5100/252 was used for the development of this project. The ICE 5100/252 in-circuit emulator is a high-level, interactive debugging system that is used to develop and test the hardware and software of a target system based on the MCS-51 family of microcontrollers.

The emulator offers the following features:

* Precise, Full speed, Real-Time Emulation.
* 64KB of Mappable High-Speed Emulation Memory.
* 16 Bits Trace Program Execution Addresses and 8 Bits Trace External Events.
* Serial Link to the IBM PC AT,PC XT.
* ASM-51 and PL/M51 Language Support.
* Symbolic Debugging Enables Access to Memory Locations and Program Variables.
* Four Address Breakpoints with In-Range, Out-Of-Range, and Page Breaks.
* Equipped with the Integrated Command Directory that includes:
  - On-Line Help.
  - Syntax Guidance and Checking.
  - Dynamic Command-Entry.
  - Error Checking.
  - Command Recall.
* On-Line Disassembler and Single-Line Assembler to Help with Code Debugging.
* Built-In CRT-Oriented Text Editor.

The ICE 5100/252 can be operated without being connected to the target system (stand alone). This meant that the source code could be written prior to the hardware being developed.

The emulator's full-speed operation makes it a valuable tool for debugging hardware, including time-critical serial port, timer and external interrupt interfaces. Thus, the hardware and software can be system tested in real-time operation. When the prototype is complete, it is tested with the final version of the system software.

The ICE is then used for real-time emulation of the microcontroller to debug the system as a completed unit.

4.2. Memory Map.

The 16-bit address bus of the microcontroller is capable of addressing 64Kbytes of program memory. In a normal bus orientated system the address bus will be common to all chips connected to it. This means that an address generated on the address bus will be seen by every chip connected to the bus. In order for the microprocessor to address the correct chip a Memory Map of the 64Kbyte program memory is neccessary.

A layout of the memory mapping used in this project can be seen on page 20.

The address space for the external source code, as programmed into the EPROM, ranges from 0000H to 1FFFH. This represents 8Kbytes of code memory. Thus by generating any addresses from 0000H up to 1FFFH, the microcontroller will only select the EPROM. Similarly, by generating addresses unique to a specific address space allocated on the Memory Map, the microcontroller will be able to select any of the remaining chips.

Consulting the memory map on page 20, we see that the next address space is allocated to the external RAM, ranging from 2000H to 3FFFH. This represents 8Kbytes of data memory.

Space for the USART is allocated from address 4000H to 4001H, with addresses 4003H to 5FFFH remaining spare for future use.

When initializing the USART, a CONTROL WORD is normally sent to initialize the device, followed by the DATA sent to or from the CPU. Therefore address 4000H will represent DATA to or from the CPU, while address 4001H represents a CONTROL WORD. (Appendixes D-2 & D-4 show how the USART is connected to the address bus).

MEMORY MAP

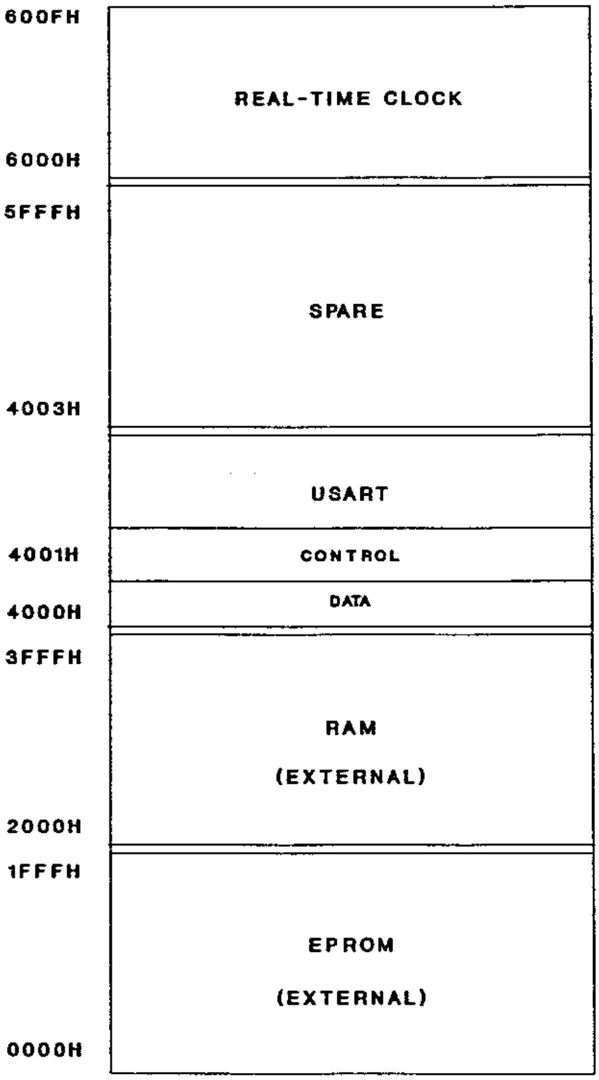

Table.1.

The addresses of the real-time clock are allocated at the top of the memory map ranging from 6000H to 600FH.
Table 1 on page 20 shows the address decoding of the real-time clock internal registers.

The memory was mapped in such a way that address 6000H represents the control register (0) and address 600FH represents the clock setting/interrupt registers, with the addresses in between making up the rest of the internal registers of the real-time clock.

4.3. Address Decoding.

In a hardware design like the one discussed here, the memory mapping and the decoding of the source code go hand in hand. The decoder relies totally on the memory map to distinguish between the different chips it must select.

In the diagram below (Fig.4.), it can be seen how the decoder chip will interpret the addresses on its inputs:

ADDRESS-PINS (AD0 - AD7 & A8 -A15) :-

A15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	AD0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000H
0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1FFFH
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2000H
0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3FFFH
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4000H
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4001H
0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	6000H
0	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	600FH

Fig.4.

Address pins A14 & A13 were used to select the different memory positions in the map, ex. '00' selected the EPROM while '01' selected the RAM etc.
The address decoding is done by a demultiplexer (2-line-to-4-line decoder) chip - 74LS139.
Appendix D-2 shows the decoder chip (U2A) connected to the address bus.

4.4. Assembler programs.

Assembler language programs translate directly into machine instructions which instruct the processor as to what operation it should perform. The language used for this application is the ASM51 Assembler used by the INTEL MCS-51 family of processors.

4.4.1. Overall system working. (Mainflow)

Appendix B-2 shows a flowchart - Mainflow, describing the overall system working. Applying power for the first time to the system causes a hardware reset to the FDC's CPU. On reset the CPU will initialize the various external chips connected to it, a more detailed layout of the FDC working can be seen in the flowchart - Fuelflow (Appendix B-3).

Simultaneously, the CAD will also reset itself - see flowchart - Cadflow (Appendix B-5). The person installing the system will be asked to enter a system password which is checked by the CAD. If the password is illegal the system will be shut down. Provided that the password is correct, the person will be asked for the telephone number of the remote dial-up modem by the CAD and the number will be sent to the FDC. After setting the date and time of the real-time clock the system is ready to dispense fuel at the user's request.

When the user inserts his card into the CAD power is applied to the card. The card is validated and the user is requested to enter his personal PIN code. If the PIN is valid the user supplies the odometer reading to the CAD. The dispenser is activated by the FDC, which monitors the fuel flow and the retrieving sensor. Activation of the retrieve sensor causes the FDC to switch off the dispenser. The fuel consumption of the vehicle is calculated using the information read from the smart card together with the information stored in the FDC's memory. The odometer information is updated on the smart card by the CAD, power is then removed from the card. As the user pulls out the card the FDC will check its available memory capacity, if the memory is full it will download the information to the control room via the modem link and return to a wait state for the next user to insert his card.

4.4.2. Fuel Dispenser Controller. (FDC)

The FDC forms the heart of the fuel dispensing system. Apart from housing the real-time clock for accurate time keeping, monitoring fuel flow and calculating fuel consumption, it also controls the autodialer board and provide the neccessary modem handshaking. In the event of a power failure the information in the memory is downloaded via the modem link, an alarm is raised on the remote side and the FDC is put into a low power consumption mode (IDLE MODE).

A more detailed layout can be seen in Appendix B-3 (Fuelflow) and B-4 (Failflow).

4.4.3. Card Access Device. (CAD)

Although the CAD appears to be controlling the whole system it is actually acting under the control of the FDC. The CAD forms a so called "interface" between the FDC and the user. Several results of procedures executed by the FDC are displayed by the CAD, in some cases where variables are required by the FDC to perform a certain function, (ex. date & time setting). The information is entered via the CAD's keypad and then sent to the FDC to process. The CAD also performs some of the calculations such as verifying the

SYSTEM PASSWORD and user PIN, detecting the smart card's presence and communicating with it, displaying user friendly message to ensure efficient system usage and keeping track of overall system working. Appendix B-5 shows a more detailed description (Cadflow).

4.4.4. Programming the Smart Card.

A device called the TLP 224 Card Exerciser is used to program information on the card. The TLP 224 is a manual insertion memory card reader. It is connected to a terminal or micro-computer through a RS 232 communication link using DTR and RTS as handshaking signals. The baud rate is set with dip switches to support 1200 up to 9600 bauds.

A basic description of how to program the Smart Card follows:

- connect the TLP 224 to the computer's serial port (COM1).
- apply power.
- run TLP 224 Card Exerciser software.
- insert Smart Card.

```
                    TLP 0224 EXERCISER


     Mask ID:                          <F1>  Power on
                                       <F10> Quit
     Opcode :
                                       Card  OFF
     Addr HI:
                                       <+> Backspace
     Addr LO:                          <-> Restart

     Bytes  :
```

Fig.5.

Fig.5. shows the opening window to the TLP 224 Exerciser program.

Power on the card by pressing F1, the card will reply with a status summary:-

```
"Data Submitted:   "60 04 6E 02 00 00 08"
"Data Returned :   "60 0F 00 18 02 0B C0 65 11 25 00 00 24 09
                    EB 90 00 B9"
```

Send a password to the card in the following format:-

```
"BC 20 00 00 08 ** ** ** **"
```

BC = Mask ID
20 = Opcode
00 = Addr HI
00 = Addr LO
08 = Number of bytes send to the card.
** = Password

If the password is correct the "Data Returned:" will appear as follows:-

```
"60 03 00 90 00 F3"
```

After the password the card will be looking for a validation read command:-

```
"BC 40 FF FF 00"
```

The card is now initialized and ready to execute any opcode sent to it by the programmer via the TLP 224.

Table.2. below shows a list of opcodes that the programmer needs in order to initialize and program the card.

Opcodes:	Remarks:
10	Primary issuer key
20	Password
40	Validation Read
50	Lock (4 bytes)
70	Validation Write
80	Telepass write
A0	Search on argument
B0	Read
C0	Telepass read
D0	Write
0E	Erase

Table.2.

4.5. Pascal program - Control station.

Pascal (Version 5.5) was used to write the control station program because of its programming ease and powerful instruction set.

It provides a quick and effective way of logging the information downloaded from the FDC. The information is stored on floppy disks which makes access to and filing of information easier. Printing the information out on a printer can save a lot on time that is normally spent in maintaining a logbook system as used by some companies. By writing special error checking routines malpractices that may exist will show up and can be tracked down to a specific vehicle, driver, date and time.

The program as such is merely a demonstration program, forming a basis for future development.

5. POWER.

The FDC is powered from a mains fed 5 volt power supply offering power failure detection.

5.1. Power Supply Unit. (PSU)

A 220 V (1 Amp) mains transformer with a 12 VAC output is used as the power source. The 12 VAC output is rectified by a fullwave bridge configuration. The output of the bridge is connected to a voltage regulator (LM 317T) via a smoothing capacitor. The output of the voltage regulator goes via another smoothing capacitor and a diode to the processor board.

The output of the voltage regulator can be adjusted to deliver 5 volts at the processor pins (+5v & GND).

5.2. Power fail detection.

In the event of a power failure the information stored in the FDC's memory needs to be downloaded in order to retain it for later use. A 6 V Ni-cad battery with a 450 milliampere hour capacity supplies enough current to the processor board to download the information before going into IDLE MODE (low consumption mode).

The two diodes used in the circuit in Appendix D-6 allows the processor board to draw power from the regulated 5 V output when powered from mains, or from the Ni-cad during power failure.

Power fail detection is achieved by connecting the input to the regulator to interrupt 0 of the microprocessor.

5.3. Surge suppression circuit.

When a power failure occurs it causes high voltage spikes which can reset the microprocessor. An RC surge suppression configuration as seen on the primary side of the mains transformer solved this potential problem by shorting high frequency spikes to ground. (See Appendix D-6)

6. PROBLEMS ENCOUNTERED.

Of all the problems encountered the following are worth mentioning:-

6.1. Handshaking between FDC and CAD.

It is vital that synchronization between the FDC and the CAD is always maintained to ensure that whenever the FDC is sending a command to the CAD, that the CAD will be ready to execute the command or send data.

The use of interrupts was considered initially so that the FDC would generate an interrupt to get the CAD's attention. However, due to the fact that the CAD provides no external inputs to connect an interrupt source to, it was decided to use control characters generated by the FDC and send them via the serial port to the CAD.

The CAD polls its receive pin to check for incoming control characters from the FDC.

6.2. Debugging the CAD's source code.

The CAD is manufactured using surface mount assembly (SMA) technology, including the CPU chip (80C31BH) which is moulded into a miniature PLCC package.

The above-mentioned physical dimensions of the CPU made it impossible to use the INTEL ICE for real-time emulation. Consequently the CAD's EPROM had to be reprogrammed every time a change was made to the software.

This meant unplugging the EPROM, erasing it with ultraviolet light, burning it again with the changed source code and plugging it back into the CAD. This process proved to be tedious and time consuming.

An EPROM simulator would have been of great assistance but unfortunately none were available.

6.3. Initialization of the USART.

When power is first applied, the USART may initialise in the mode, sync character or command instruction format. To guarantee that the device is in the command instruction format before the reset command is issued, a worst-case initialization sequence had to be executed (sync mode with two sync characters).

Loading three 00Hs consecutively into the device with $C/\overline{D} = 1$ configures sync operation and writes two dummy 00H sync characters. An internal reset command (40H) may then be issued to return the device to the "Idle" state. The device can now be programmed for the appropriate transmission mode.

6.4. Designing the Autodialer.

A double pole double throw (DPDT) relay was used to seize the telephone line, pulse out the number and connect the modem to the line.

On the one side of the dpdt contacts a loop resistor was connected, with the modem on the other side and the telephone line connected to the traveller. When the relay is pulsing out the number the dpdt contacts switch between the loop resistor connected to one side of the contacts and the modem on the other side. The 600 ohm line transformer of the modem, connected across the telephone line, caused it to be loaded and prevented the line from being seized.

The use of opto-couplers to completely isolate the modem from the line while dialing and by connecting the latter to the line after the call was established, solved this problem.

6.5. Power Surges.

While experimenting with the power failure circuitry, it was discovered that when a power failure occurred, (mains failure), it caused spurious voltages in the ac supply which were induced into the secondary winding of the mains transformer and eventually into the 5 volt dc supply.

This produced a flick on the 5 volt supply large enough to reset the USART chip, resulting in a communication failure. The problem was overcome by using a surge suppression circuit as described in paragraph 5.3.

7. CONCLUSION.

The fuel dispenser controller conforms to all the specifications required in the objective at the beginning of this thesis.

A retrieve sensor, not mentioned in the system specifications , was added to provide stricter dispenser control.

Suggestions on future improvements can be seen in the next chapter.

8. FUTURE SUGGESTIONS.

The fuel dispenser controller discussed in this thesis is a prototype system and is open to further development and enhancements.

Some suggestions on how to improve the current system follow:-

8.1. Communication failure.

A failure in communication, whether it's caused by a faulty telephone line, modem or communication device (USART), could cripple the system.

By indicating a communication failure by means of an alarm condition on the CAD, the user could immediately see that the system is off-line and report it to the control room.

The information stored in memory can be downloaded onto a Smart card specially assigned for that purpose.

8.2. Optimal System Usage.

Presently the Smart card stays in the cardreader until the user has dispensed the amount of fuel needed.

By altering the system software to allow the user to do card and PIN validation, withdraw the card, dispense the amount of fuel needed and insert the card again to update the odometer information, more users can be accommodated in the time it takes to service one user.

8.3. Stricter flow measurement.

The control program running in the control room computer can be altered to check vehicle fuel tank capacity against liters dispensed, illegal values will point out malpractices or mechanical problems for a specific vehicle.

8.4. Electronic Dispensers.

The system is designed to work with mechanical fuel dispensers but can easily be modified to work with electronic dispensers.

Using the receive data (RXD) pin on the USART and the neccessary software, a vast amount of information can be downloaded from an electronic dispenser via its serial port.

The information includes data such as total litres dispensed by the dispenser, average fuel flow, underground tank capacities, etc. In a commercialized application the rate for fuel per litre can be changed via the serial port.

8.5. Hardware Integration.

The system can be designed around a single microprocessor, thereby eliminating the CAD by using the same CPU that controls the FDC to also control the cardreader hardware, 16 key keyboard and alphanumeric LCD display that make up the CAD.

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9. BIBLIOGRAPHY.

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RS Components Ltd.

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National Semiconductor Company.

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Philips ECG Incorporated.

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Borland International.

CAD Assembler Routines (AKL 200 V4.4)
Bull CP8.

TLP 224 User Manual.
Bull CP8.

10. LIST OF ABBREVIATIONS.

ALE	Address Latch Enable.
CAD	Card Access Device.
CLK	Clock.
CMOS	Complementary Metal Oxide Semiconductor.
CPU	Central Processing Unit.
CTS	Clear to Send.
DIP	Dual In line Package.
DPDT	Double Pole Double Throw.
DSR	Data Set Ready.
DTR	Data Terminal Ready.
EEPROM	Electrically Erasable Programmable ROM.
FDC	Fuel Dispenser Controller.
GND	Ground.
I.C.	Integrated Circuit.
ICE	In Circuit Emulator.
I/O	Input/Output. (Communication ports)
LCD	Liquid Crystal Display.
LED	Light Emitting Diode.
NI -CAD	Nickel Cadmium. (Battery)
PC	Personal Computer.
PGM	Program.
PIN	Personal Identification Number.
PLCC	Pin Lead Chip Carrier.
PSEN	Program Strobe Enable.
PSU	Power Supply Unit.
RAM	Random Access Memory.
RI	Receive Interrupt.
ROM	Read Only Memory.
RTS	Request To Send.
RXC	Receive Clock.
RXD	Receive Data.
RXRDY	Receive Ready.
SMA	Surface Mount Assembly.
SPOM	Self-Programmable One Chip Microcomputer.
TD	Transmit Data. (Modem)
TI	Transmit Interrupt.
TTL	Transistor Transistor Logic.

TXC - Transmit Clock.

TXD - Transmit Data. (CPU)

TXEMPTY - Transmit Empty.

TXRDY - Transmit Ready.

uP - Microprocessor.

USART - Universal Synchronous Asynchronous Receiver Transmitter.

APPENDIX A.

System setup.

WARNING !!!!   BEFORE APPLYING POWER.

1. Connect the following cables:

FDC:
- Modem socket to Modem.
- Dispenser socket to Dispenser.
- CAD socket to CAD.

SWITCH ON POWER.

2. RESET FDC.

Press the RESET button at the back of the FDC cabinet. Observe the TD led on the modem. It should flicker for a couple of seconds, indicating that the FDC is reset. If the TD led does not flicker when the RESET button is pressed, repeat the process by holding it in for a little longer until the FDC resets.

3. RESET CAD.

The CAD should display "SYSTEM PASSWORD" when the 12V power supply is applied to it, if not, first unplug the 12V power supply and then plug it in again until the PASSWORD message is displayed.

4. ENTER PASSWORD.

The system password can only be entered by the system operator, and is only known to him.

5. ENTER TELEPHONE NUMBER.

Follow the instructions on the CAD on how to enter the telephone number of the remote dial-up Modem.

6. SET DATE/TIME.

Follow the instructions on the CAD on how to set the DATE and TIME.

7. TEST COMMS PORT.

The CAD transmits the message "TESTING THE CARDREADERS COMMS PORT", this can be used to test the serial port of the CAD when installing the system for the first time.

8. NORMAL SYSTEM WORKING.

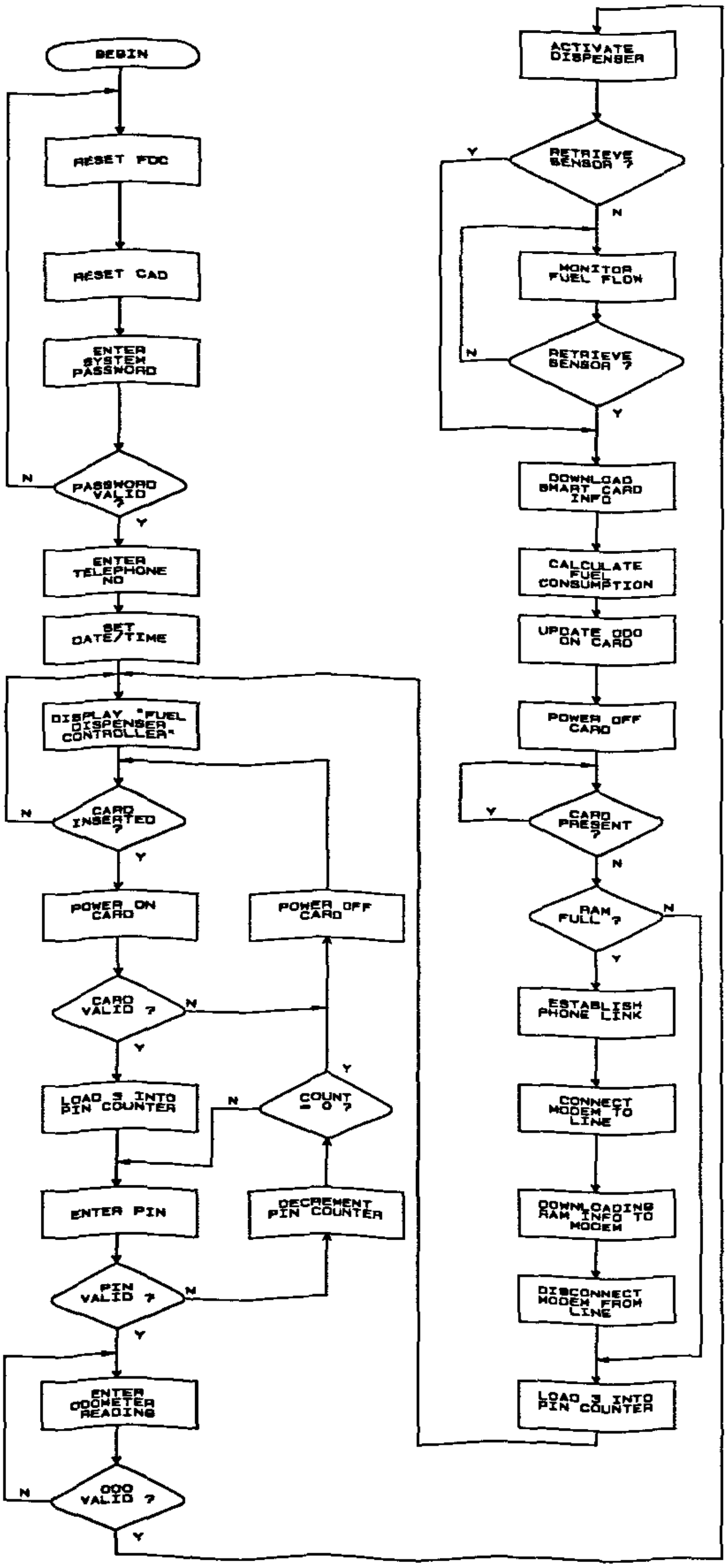
The CAD is now setup for proper system working and the user will be guided by user friendly commands on the display of the CAD.

APPENDIX B.

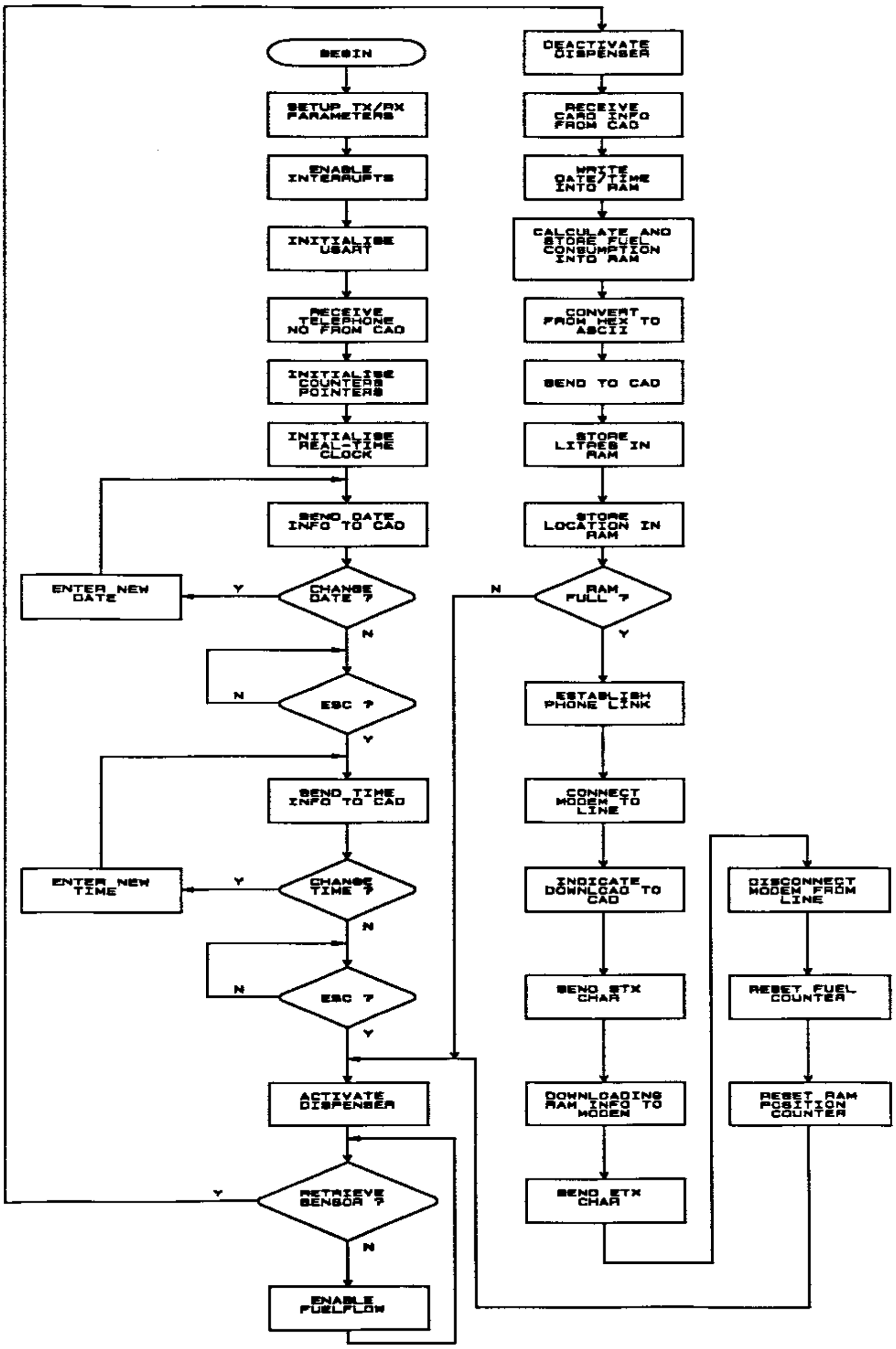
Flowcharts.

INDEX.

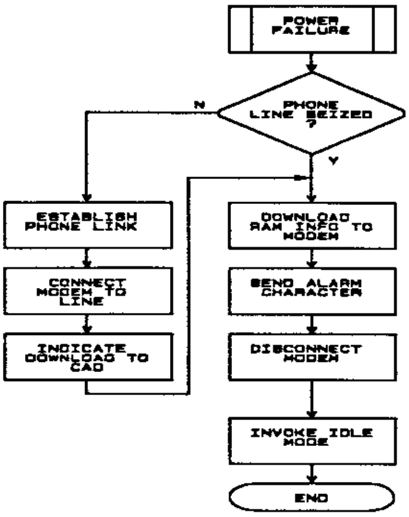
Mainflow.


BEGIN
RESET FDC
RESET CAD
ENTER SYSTEM PASSWORD
PASSWORD VALID ?
N
Y
ENTER TELEPHONE NO
SET DATE/TIME
DISPLAY "FUEL DISPENSER CONTROLLER"
CARD INSERTED ?
N
Y
POWER ON CARD
CARD VALID ?
N
Y
POWER OFF CARD
LOAD 3 INTO PIN COUNTER
COUNT = 0 ?
N
Y
ENTER PIN
DECREMENT PIN COUNTER
PIN VALID ?
N
Y
ENTER ODOMETER READING
ODO VALID ?
N
Y
ACTIVATE DISPENSER
RETRIEVE SENSOR ?
Y
N
MONITOR FUEL FLOW
RETRIEVE SENSOR ?
N
Y
DOWNLOAD SMART CARD INFO
CALCULATE FUEL CONSUMPTION
UPDATE ODO ON CARD
POWER OFF CARD
CARD PRESENT ?
Y
N
RAM FULL ?
N
Y
ESTABLISH PHONE LINK
CONNECT MODEM TO LINE
DOWNLOADING RAM INFO TO MODEM
DISCONNECT MODEM FROM LINE
LOAD 3 INTO PIN COUNTER

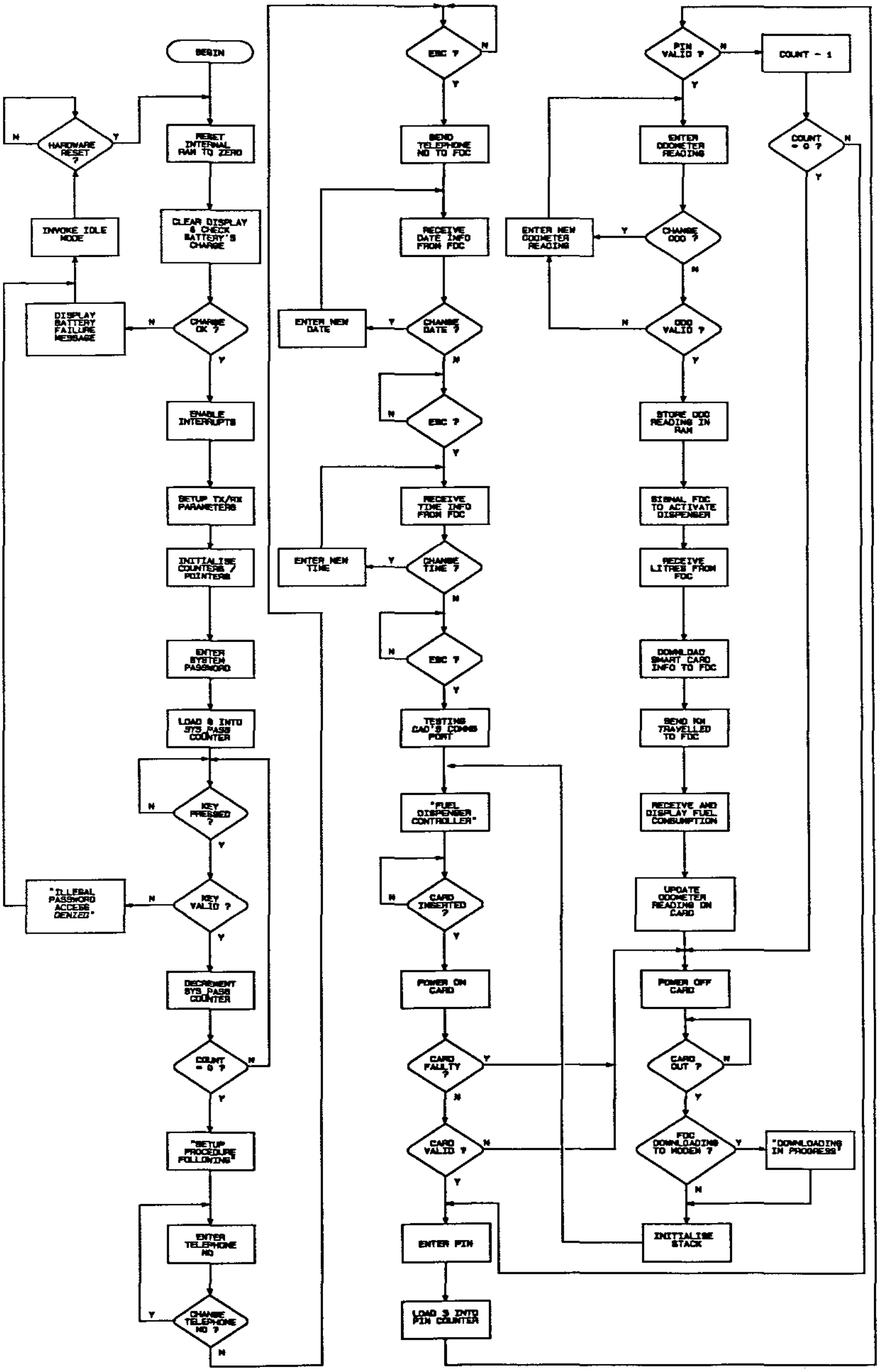
Fuelflow.


BEGIN
SETUP TX/RX PARAMETERS
ENABLE INTERRUPTS
INITIALISE USART
RECEIVE TELEPHONE NO FROM CAD
INITIALISE COUNTERS POINTERS
INITIALISE REAL-TIME CLOCK
SEND DATE INFO TO CAD
CHANGE DATE ?
Y
ENTER NEW DATE
N
ESC ?
N
Y
SEND TIME INFO TO CAD
CHANGE TIME ?
Y
ENTER NEW TIME
N
ESC ?
N
Y
ACTIVATE DISPENSER
RETRIEVE SENSOR ?
Y
N
ENABLE FUELFLOW
DEACTIVATE DISPENSER
RECEIVE CARD INFO FROM CAD
WRITE DATE/TIME INTO RAM
CALCULATE AND STORE FUEL CONSUMPTION INTO RAM
CONVERT FROM HEX TO ASCII
SEND TO CAD
STORE LITRES IN RAM
STORE LOCATION IN RAM
RAM FULL ?
N
Y
ESTABLISH PHONE LINK
CONNECT MODEM TO LINE
INDICATE DOWNLOAD TO CAD
SEND STX CHAR
DOWNLOADING RAM INFO TO MODEM
SEND ETX CHAR
DISCONNECT MODEM FROM LINE
RESET FUEL COUNTER
RESET RAM POSITION COUNTER

Failflow.


POWER FAILURE
PHONE LINE SEIZED ?
N
Y
ESTABLISH PHONE LINK
CONNECT MODEM TO LINE
INDICATE DOWNLOAD TO CAD
DOWNLOAD RAM INFO TO MODEM
SEND ALARM CHARACTER
DISCONNECT MODEM
INVOKE IDLE MODE
END

Cadflow.


BEGIN
HARDWARE RESET ?
N
Y
RESET INTERNAL RAM TO ZERO
INVOKE IDLE MODE
CLEAR DISPLAY & CHECK BATTERY'S CHARGE
DISPLAY BATTERY FAILURE MESSAGE
CHARGE OK ?
N
Y
ENABLE INTERRUPTS
SETUP TX/RX PARAMETERS
INITIALISE COUNTERS / POINTERS
ENTER SYSTEM PASSWORD
LOAD 8 INTO SYS PASS COUNTER
KEY PRESSED ?
N
Y
"ILLEGAL PASSWORD ACCESS DENIED"
KEY VALID ?
N
Y
DECREMENT SYS PASS COUNTER
COUNT = 0 ?
N
Y
"SETUP PROCEDURE FOLLOWING"
ENTER TELEPHONE NO
CHANGE TELEPHONE NO ?
Y
N
ESC ?
N
Y
SEND TELEPHONE NO TO FDC
RECEIVE DATE INFO FROM FDC
ENTER NEW DATE
CHANGE DATE ?
Y
N
ESC ?
N
Y
RECEIVE TIME INFO FROM FDC
ENTER NEW TIME
CHANGE TIME ?
Y
N
ESC ?
N
Y
TESTING CAD'S COMMS PORT
"FUEL DISPENSER CONTROLLER"
CARD INSERTED ?
N
Y
POWER ON CARD
CARD FAULTY ?
Y
N
CARD VALID ?
N
Y
ENTER PIN
LOAD 3 INTO PIN COUNTER
PIN VALID ?
N
Y
COUNT - 1
COUNT = 0 ?
N
Y
ENTER ODOMETER READING
ENTER NEW ODOMETER READING
CHANGE ODO ?
Y
N
ODO VALID ?
N
Y
STORE ODO READING IN RAM
SIGNAL FDC TO ACTIVATE DISPENSER
RECEIVE LITRES FROM FDC
DOWNLOAD SMART CARD INFO TO FDC
SEND KM TRAVELLED TO FDC
RECEIVE AND DISPLAY FUEL CONSUMPTION
UPDATE ODOMETER READING ON CARD
POWER OFF CARD
CARD OUT ?
N
Y
FDC DOWNLOADING TO MODEM ?
Y
N
"DOWNLOADING IN PROGRESS"
INITIALISE STACK

APPENDIX C.

Program listings.

INDEX.

```
DOS 3.30 (038-N) MCS-51 MACRO ASSEMBLER, V2.2
OBJECT MODULE PLACED IN DISP.OBJ
ASSEMBLER INVOKED BY:  C:\PRODISK\SCRATCH\ASM51.EXE DISP.SRC


LOC  OBJ            LINE     SOURCE

                       1
                       2                NAME  DISPENSER
  REG                  3                ACCUM EQU A
  0087                 4                PCON  DATA 87H
                       5
                       6                CSEG  AT 0000H
                       7
0000                   8                ORG   00H
0000 020030            9                LJMP  INIT
                      10
0003                  11                ORG   0003H
0003 0206E3           12                LJMP  FAIL
                      13
0013                  14                ORG   0013H
0013 0203F4           15                LJMP  INTR1
                      16
0030                  17                ORG   30H
                      18
                      19       ;---------------------------- INITIALIZE FDC -----------------------------
                      20
                      21       INIT:
  0020                22                OP_3     DATA 20H
  0021                23                OP_2     DATA 21H
  0022                24                OP_1     DATA 22H
  0023                25                OP_0     DATA 23H
  0024                26                TMP_3    DATA 24H
  0025                27                TMP_2    DATA 25H
  0026                28                TMP_1    DATA 26H
  0027                29                TMP_0    DATA 27H
  0028                30                DIV_1    DATA 28H
  0029                31                DIV_0    DATA 29H
  002A                32                SUB_3    DATA 2AH
  002B                33                SUB_2    DATA 2BH
  002C                34                SUB_1    DATA 2CH
  002D                35                SUB_0    DATA 2DH
                      36
0030 758DFD           37                MOV   TH1,#0FDH             ;SETTING UP
0033 758B00           38                MOV   TL1,#000H             ;TX & RX
0036 53877F           39                ANL   PCON,#7FH             ;PARAMETERS
0039 758920           40                MOV   TMOD,#20H             ;
003C 759853           41                MOV   SCON,#53H             ;
003F D28E             42                SETB  TR1                   ;
                      43
0041 D2AF             44                SETB  EA                    ;
0043 D2A8             45                SETB  EX0                   ;INT0
0045 D2B2             46                SETB  P3.2                  ;ENABLE
0047 D2B3             47                SETB  P3.3                  ;INT1
0049 D2B8             48                SETB  PX0                   ;priority setting
004B C288             49                CLR   IT0                   ;
004D C28A             50                CLR   IT1                   ;
```

```
LOC  OBJ            LINE     SOURCE

                      51
004F 120278           52                 LCALL DELAY
0052 120278           53                 LCALL DELAY
                      54
                      55     ;------------------------------ INITIALIZE USART ---------------------------
                      56
0055 7400             57                 MOV   A,#00H
0057 904001           58                 MOV   DPTR,#4001H
005A F0               59                 MOVX  @DPTR,A
005B F0               60                 MOVX  @DPTR,A
005C F0               61                 MOVX  @DPTR,A
                      62
005D 7440             63                 MOV   A,#01000000B           ;
005F 904001           64                 MOV   DPTR,#4001H            ;RESET USART
0062 F0               65                 MOVX  @DPTR,A                ;
                      66
0063 74CA             67                 MOV   A,#11001010B           ;2 STOP BITS / NONE PARITY
0065 F0               68                 MOVX  @DPTR,A                ;7 DATA / 16X
                      69                                              ;___   ___
0066 7433             70                 MOV   A,#00110011B           ;RTS / DTR = LOW
0068 F0               71                 MOVX  @DPTR,A                ;TX ENABLE / ERROR RESET
                      72
0069 120278           73                 LCALL DELAY
                      74
006C 90008D           75     BEGIN:      MOV   DPTR,#USATX
006F E4               76     NEXT_CHR:   CLR   A
0070 93               77                 MOVC  A,@A+DPTR
0071 6046             78                 JZ    CONT_INIT
0073 12007A           79                 LCALL TST
0076 A3               80                 INC   DPTR
0077 02006F           81                 LJMP  NEXT_CHR
                      82
007A C082             83     TST:        PUSH  DPL
007C C083             84                 PUSH  DPH
007E 904000           85                 MOV   DPTR,#4000H
0081 F0               86                 MOVX  @DPTR,A
0082 A3               87                 INC   DPTR
                      88
0083 E0               89     TXRDY:      MOVX  A,@DPTR
0084 5401             90                 ANL   A,#01H
0086 60FB             91                 JZ    TXRDY
                      92
0088 D083             93                 POP   DPH
008A D082             94                 POP   DPL
008C 22               95                 RET
                      96
008D 496E6974         97     USATX:      DB 'Initalizing USART for transmision !!!!!!!!!',00H
0091 616C697A
0095 696E6720
0099 55534152
009D 5420666F
00A1 72207472
00A5 616E736D
00A9 6973696F
00AD 6E202121
```

```
LOC  OBJ            LINE     SOURCE

00B1 21212121
00B5 212121
00B8 00
                      98
                      99     ;---------------------------- STORE TELEPHONE NO -------------------------
                     100
00B9 903FF0          101     CONT_INIT:    MOV   DPTR,#3FF0H
00BC 1200CB          102     LOOK_DIGIT:   LCALL RECV
00BF B44504          103                   CJNE  A,#45H,STORE_DIGIT
00C2 F0              104                   MOVX  @DPTR,A
00C3 020003          105                   LJMP  RX
                     106
00C6 F0              107     STORE_DIGIT:  MOVX  @DPTR,A
00C7 A3              108                   INC   DPTR
00C8 0200BC          109                   LJMP  LOOK_DIGIT
                     110
00CB 3098FD          111     RECV:         JNB   RI,$
00CE E599            112                   MOV   A,SBUF
00D0 C298            113                   CLR   RI
00D2 22              114                   RET
                     115
00D3 3098FD          116     RX:           JNB   RI,$
00D6 E599            117                   MOV   A,SBUF
00D8 C298            118                   CLR   RI
                     119
00DA 6444            120                   XRL   A,#44H                ;LOOK HANDSHAKE
00DC 70F5            121                   JNZ   RX                    ;FROM CARDREADER
                     122
                     123     ;---------------------------- INITIALIZE REAL-TIME CLOCK -------------------
                     124
00DE 754060          125                   MOV   40H,#60H              ;CLOCK ADDR
00E1 754102          126                   MOV   41H,#02H              ;
00E4 754220          127                   MOV   42H,#20H              ;XRAM ADDR
00E7 754300          128                   MOV   43H,#00H              ;
00EA 754460          129                   MOV   44H,#60H              ;READ ADDR
00ED 75450E          130                   MOV   45H,#0EH              ;
00F0 754602          131                   MOV   46H,#02H              ;2 CHARS COUNTER
00F3 754703          132                   MOV   47H,#03H              ;DATE LENGTH COUNTER
00F6 754820          133                   MOV   48H,#20H              ;XRAM ADDR
00F9 754900          134                   MOV   49H,#00H              ; "      "
00FC 755007          135                   MOV   50H,#07H              ;LOAD COUNTER
00FF 755102          136                   MOV   51H,#02H
0102 756000          137                   MOV   60H,#00H              ;FUEL COUNTER
0105 756869          138                   MOV   68H,#69H              ;RAM_USED_COUNTER 6BH = RAM FULL
0108 758107          139                   MOV   SP,#07H               ;INIT STACK
                     140
010B 740F            141                   MOV   A,#0FH                ;15 INTO CONTREG
010D 906000          142                   MOV   DPTR,#6000H
0110 F0              143                   MOVX  @DPTR,A
                     144
0111 7400            145                   MOV   A,#00H                ;0 INTO INTRREG
0113 90600F          146                   MOV   DPTR,#600FH
0116 F0              147                   MOVX  @DPTR,A
                     148
0117 7405            149                   MOV   A,#05H                ;CLOCK SET
```

```
LOC  OBJ            LINE     SOURCE

0119 906000          150                  MOV   DPTR,#6000H
011C F0              151                  MOVX  @DPTR,A
                     152
011D 7401            153                  MOV   A,#01H                   ;24H MODE
011F 90600F          154                  MOV   DPTR,#600FH
0122 F0              155                  MOVX  @DPTR,A
                     156
                     157     ;-------------------- LOAD 00H INTO CLOCK REGS-----------------------------
                     158
0123 7400            159     LOAD_REGS:   MOV   A,#00H
0125 854083          160                  MOV   DPH,40H
0128 854182          161                  MOV   DPL,41H
012B F0              162                  MOVX  @DPTR,A
012C A3              163                  INC   DPTR
012D E582            164                  MOV   A,DPL
012F 640F            165                  XRL   A,#0FH
0131 6008            166                  JZ    CLOCK_START
0133 858340          167                  MOV   40H,DPH                  ;POINTER
0136 858241          168                  MOV   41H,DPL
0139 2123            169                  AJMP  LOAD_REGS
                     170
                     171     ;----------------------START CLOCK -----------------------------------------
                     172
013B 7400            173     CLOCK_START: MOV   A,#00H
013D 906000          174                  MOV   DPTR,#6000H
0140 F0              175                  MOVX  @DPTR,A
                     176
                     177     ;-----------------------READ  DATE-----------------------------------------
                     178
0141 906000          179     READ:        MOV   DPTR,#6000H              ;RESET
0144 E0              180                  MOVX  A,@DPTR                  ;DCF
                     181
0145 854483          182     AGAIN:       MOV   DPH,44H
0148 854582          183                  MOV   DPL,45H
014B E0              184                  MOVX  A,@DPTR
014C 540F            185                  ANL   A,#0FH
014E 4430            186                  ORL   A,#30H
                     187
0150 C0E0            188                  PUSH  ACC
0152 6431            189                  XRL   A,#31H
0154 900255          190                  MOV   DPTR,#DAY1
0157 6044            191                  JZ    DAYS
0159 D0E0            192                  POP   ACC
                     193
015B C0E0            194                  PUSH  ACC
015D 6432            195                  XRL   A,#32H
015F 90025A          196                  MOV   DPTR,#DAY2
0162 6039            197                  JZ    DAYS
0164 D0E0            198                  POP   ACC
                     199
0166 C0E0            200                  PUSH  ACC
0168 6433            201                  XRL   A,#33H
016A 90025F          202                  MOV   DPTR,#DAY3
016D 602E            203                  JZ    DAYS
016F D0E0            204                  POP   ACC
```

```
LOC  OBJ            LINE     SOURCE

                     205
0171 C0E0            206                PUSH  ACC
0173 6434            207                XRL   A,#34H
0175 900264          208                MOV   DPTR,#DAY4
0178 6023            209                JZ    DAYS
017A D0E0            210                POP   ACC
                     211
017C C0E0            212                PUSH  ACC
017E 6435            213                XRL   A,#35H
0180 900269          214                MOV   DPTR,#DAY5
0183 6018            215                JZ    DAYS
0185 D0E0            216                POP   ACC
                     217
0187 C0E0            218                PUSH  ACC
0189 6436            219                XRL   A,#36H
018B 90026E          220                MOV   DPTR,#DAY6
018E 600D            221                JZ    DAYS
0190 D0E0            222                POP   ACC
                     223
0192 C0E0            224                PUSH  ACC
0194 6437            225                XRL   A,#37H
0196 900273          226                MOV   DPTR,#DAY7
0199 6002            227                JZ    DAYS
019B D0E0            228                POP   ACC
                     229
019D E4              230     DAYS:      CLR   A
019E 93              231                MOVC  A,@A+DPTR
019F 601F            232                JZ    TYD
01A1 C083            233                PUSH  DPH
01A3 C082            234                PUSH  DPL
01A5 854283          235                MOV   DPH,42H
01A8 854382          236                MOV   DPL,43H
01AB F0              237                MOVX  @DPTR,A
01AC A3              238                INC   DPTR
01AD 858342          239                MOV   42H,DPH
01B0 858243          240                MOV   43H,DPL
01B3 D082            241                POP   DPL
01B5 D083            242                POP   DPH
                     243
01B7 12023F          244                LCALL TX
01BA 120278          245                LCALL DELAY
01BD A3              246                INC   DPTR
01BE 219D            247                AJMP  DAYS
                     248
01C0 854483          249     TYD:       MOV   DPH,44H
01C3 854582          250                MOV   DPL,45H
01C6 AF82            251                MOV   R7,DPL
01C8 1F              252                DEC   R7
01C9 8F82            253                MOV   DPL,R7
01CB E0              254                MOVX  A,@DPTR
01CC 540F            255                ANL   A,#0FH
01CE 4430            256                ORL   A,#30H
01D0 513F            257                ACALL TX
01D2 120278          258                LCALL DELAY
01D5 858344          259                MOV   44H,DPH
```

```
LOC  OBJ            LINE     SOURCE

01D8 858245          260                   MOV   45H,DPL
01DB 854283          261                   MOV   DPH,42H
01DE 854382          262                   MOV   DPL,43H
01E1 F0              263                   MOVX  @DPTR,A
01E2 A3              264                   INC   DPTR
01E3 858342          265                   MOV   42H,DPH
01E6 858243          266                   MOV   43H,DPL
01E9 C0E0            267                   PUSH  ACC
01EB E546            268                   MOV   A,46H
01ED 14              269                   DEC   A
01EE F546            270                   MOV   46H,A
01F0 540F            271                   ANL   A,#0FH
01F2 6004            272                   JZ    EXIT
01F4 D0E0            273                   POP   ACC
01F6 31C0            274                   ACALL TYD
                     275
01F8 D0E0            276     EXIT:         POP   ACC
01FA C082            277                   PUSH  DPL
01FC C083            278                   PUSH  DPH
01FE 906000          279                   MOV   DPTR,#6000H
0201 E0              280                   MOVX  A,@DPTR
0202 906000          281                   MOV   DPTR,#6000H
0205 E0              282                   MOVX  A,@DPTR
0206 D083            283                   POP   DPH
0208 D082            284                   POP   DPL
020A 5408            285                   ANL   A,#08H
020C 7017            286                   JNZ   RESET_DPTRS
                     287
020E E547            288                   MOV   A,47H
0210 14              289                   DEC   A
0211 F547            290                   MOV   47H,A
0213 7003            291                   JNZ   WEER
0215 020286          292                   LJMP  MES1
                     293
0218 754602          294     WEER:         MOV   46H,#02H
021B 742F            295                   MOV   A,#2FH
021D 513F            296                   ACALL TX
021F 120278          297                   LCALL DELAY
0222 0201C0          298                   LJMP  TYD
                     299
0225 754060          300     RESET_DPTRS:  MOV   40H,#60H
0228 754102          301                   MOV   41H,#02H
022B 754220          302                   MOV   42H,#20H
022E 754300          303                   MOV   43H,#00H
0231 754460          304                   MOV   44H,#60H
0234 75450E          305                   MOV   45H,#0EH
0237 754602          306                   MOV   46H,#02H
023A 754703          307                   MOV   47H,#03H
023D 3145            308                   ACALL AGAIN
                     309
023F C299            310     TX:           CLR   TI
0241 F599            311                   MOV   SBUF,A
0243 3099FD          312                   JNB   TI,$
0246 22              313                   RET
                     314
```

```
LOC  OBJ            LINE     SOURCE

0247 00              315     TIME:        DB 00H,00H,00H,00H,00H,00H,00H,00H,00H,00H,00H,00H,00H,0F0H
0248 00
0249 00
024A 00
024B 00
024C 00
024D 00
024E 00
024F 00
0250 00
0251 00
0252 00
0253 00
0254 F0
                     316
0255 4D4F4E20        317     DAY1:        DB 'MON ',00H
0259 00
025A 54554520        318     DAY2:        DB 'TUE ',00H
025E 00
025F 57454420        319     DAY3:        DB 'WED ',00H
0263 00
0264 54485520        320     DAY4:        DB 'THU ',00H
0268 00
0269 46524920        321     DAY5:        DB 'FRI ',00H
026D 00
026E 53415420        322     DAY6:        DB 'SAT ',00H
0272 00
0273 53554E20        323     DAY7:        DB 'SUN ',00H
0277 00
                     324
0278 C0E0            325     DELAY:       PUSH  ACC
027A 7AFF            326                  MOV   R2,#0FFH
027C 74FF            327     LOOP:        MOV   A,#0FFH
027E 14              328     PAUSE:       DEC   A
027F 70FD            329                  JNZ   PAUSE
0281 DAF9            330                  DJNZ  R2,LOOP
0283 D0E0            331                  POP   ACC
0285 22              332                  RET
                     333
0286 513F            334     MES1:        ACALL TX
0288 120278          335                  LCALL DELAY
                     336
028B E551            337                  MOV   A,51H
028D 14              338                  DEC   A
028E 605C            339                  JZ    RECEIVE
0290 F551            340                  MOV   51H,A
                     341
                     342     ;-------------------------INPUT  NEW  DATE----------------------------------
                     343
0292 3098FD          344     SET_DATE:    JNB   RI,$
0295 E599            345                  MOV   A,SBUF
0297 C298            346                  CLR   RI
                     347
0299 854883          348                  MOV   DPH,48H
029C 854982          349                  MOV   DPL,49H
```

```
LOC  OBJ            LINE     SOURCE

029F F0              350                  MOVX  @DPTR,A                  ;INPUT FROM
02A0 A3              351                  INC   DPTR                     ;CARDREADER
02A1 858348          352                  MOV   48H,DPH                  ;INTO
02A4 858249          353                  MOV   49H,DPL                  ;XRAM
02A7 E550            354                  MOV   A,50H
02A9 14              355                  DEC   A                        ;CHECK FOR
02AA 6004            356                  JZ    A10                      ;LAST CHAR
02AC F550            357                  MOV   50H,A
02AE 4192            358                  AJMP  SET_DATE
                     359
02B0 754300          360     A10:         MOV   43H,#00H
02B3 75450E          361                  MOV   45H,#0EH
02B6 7405            362     WRITE_DATE:  MOV   A,#05H                   ;
02B8 906000          363                  MOV   DPTR,#6000H              ;STOP CLOCK
02BB F0              364                  MOVX  @DPTR,A                  ;
                     365
02BC 854283          366                  MOV   DPH,42H
02BF 854382          367                  MOV   DPL,43H                  ;GET DATE
02C2 E0              368                  MOVX  A,@DPTR
02C3 540F            369                  ANL   A,#0FH
02C5 A3              370                  INC   DPTR
02C6 858342          371                  MOV   42H,DPH
02C9 858243          372                  MOV   43H,DPL
                     373
02CC 854483          374                  MOV   DPH,44H
02CF 854582          375                  MOV   DPL,45H
02D2 F0              376                  MOVX  @DPTR,A                  ;WRITE DATE
02D3 E545            377                  MOV   A,45H
02D5 14              378                  DEC   A
02D6 F545            379                  MOV   45H,A
02D8 854582          380                  MOV   DPL,45H
02DB 6407            381                  XRL   A,#07H
02DD 6002            382                  JZ    FINISH
02DF 41B6            383                  AJMP  WRITE_DATE
                     384
02E1 7400            385     FINISH:      MOV   A,#00H
02E3 906000          386                  MOV   DPTR,#6000H
02E6 F0              387                  MOVX  @DPTR,A
                     388
02E7 120278          389                  LCALL DELAY
02EA 5125            390                  ACALL RESET_DPTRS
                     391
                     392     ;--------------------------DISPLAY CURRENT TIME------------------------------
                     393
02EC 3098FD          394     RECEIVE:     JNB   RI,$
02EF E599            395                  MOV   A,SBUF
02F1 C298            396                  CLR   RI
                     397
02F3 C0E0            398                  PUSH  ACC
02F5 6444            399                  XRL   A,#44H                   ;Test for "D - DATE"
02F7 600C            400                  JZ    AA10
02F9 D0E0            401                  POP   ACC
02FB 6454            402                  XRL   A,#54H                   ;LOOK HANDSHAKE
02FD 70ED            403                  JNZ   RECEIVE                  ;FROM CARDREADER
                     404
```

```
LOC  OBJ            SOURCE

02FF 758107                         MOV   SP,#07H
0302 020328                         LJMP  TIME1

0305 D0E0           AA10:           POP   ACC
0307 754220                         MOV   42H,#20H
030A 754300                         MOV   43H,#00H
030D 754460                         MOV   44H,#60H
0310 75450E                         MOV   45H,#0EH
0313 754602                         MOV   46H,#02H
0316 754703                         MOV   47H,#03H
0319 754820                         MOV   48H,#20H
031C 754900                         MOV   49H,#00H
031F 755007                         MOV   50H,#07H
0322 755102                         MOV   51H,#02H
0325 020145                         LJMP  AGAIN

0328 120278         TIME1:          LCALL DELAY
032B 120278                         LCALL DELAY
032E 120278                         LCALL DELAY
0331 120278                         LCALL DELAY
0334 120278                         LCALL DELAY
0337 754220                         MOV   42H,#20H                  ;XRAM ADDR
033A 75430A                         MOV   43H,#0AH                  ;
033D 754460                         MOV   44H,#60H                  ;READ ADDR
0340 754507                         MOV   45H,#07H                  ;
0343 754602                         MOV   46H,#02H                  ;2 CHAR COUNTER
0346 754907                         MOV   49H,#07H
0349 758107                         MOV   SP,#07H                   ;

034C 906000         READ2:          MOV   DPTR,#6000H
034F E0                             MOVX  A,@DPTR

0350 854483         A20:            MOV   DPH,44H
0353 854582                         MOV   DPL,45H
0356 E0                             MOVX  A,@DPTR
0357 540F                           ANL   A,#0FH
0359 4430                           ORL   A,#30H

035B 12023F                         LCALL TX
035E 858344                         MOV   44H,DPH
0361 858245                         MOV   45H,DPL
0364 854283                         MOV   DPH,42H
0367 854382                         MOV   DPL,43H
036A F0                             MOVX  @DPTR,A
036B C0E0                           PUSH  ACC
036D E545                           MOV   A,45H
036F 14                             DEC   A
0370 F545                           MOV   45H,A
0372 6401                           XRL   A,#01H
0374 601D                           JZ    STOP
0376 D0E0                           POP   ACC
0378 A3                             INC   DPTR
0379 858342                         MOV   42H,DPH
037C 858243                         MOV   43H,DPL
037F E546                           MOV   A,46H
```

```
LOC  OBJ            LINE     SOURCE

0381 14              460                  DEC   A
0382 6004            461                  JZ    A30
0384 F546            462                  MOV   46H,A
0386 7150            463                  ACALL A20
                     464
0388 754602          465     A30:         MOV   46H,#02H
038B 743A            466                  MOV   A,#3AH
038D 12023F          467                  LCALL TX
0390 020350          468                  LJMP  A20
                     469
0393 12023F          470     STOP:        LCALL TX
                     471
0396 C298            472                  CLR   RI
0398 E599            473                  MOV   A,SBUF
039A C0E0            474                  PUSH  ACC
039C 6443            475                  XRL   A,#43H              ;* - CHANGE TIME
039E 6009            476                  JZ    A50
03A0 D0E0            477                  POP   ACC
03A2 6441            478                  XRL   A,#41H              ;ABORT TIME DISPLAY
03A4 6031            479                  JZ    PUMP_OFF
03A6 020328          480                  LJMP  TIME1
                     481
03A9 754460          482     A50:         MOV   44H,#60H
03AC 754507          483                  MOV   45H,#07H
03AF 7405            484                  MOV   A,#05H
03B1 906000          485                  MOV   DPTR,#6000H
03B4 F0              486                  MOVX  @DPTR,A
                     487
03B5 3098FD          488     NEW_TIME:    JNB   RI,$
03B8 E599            489                  MOV   A,SBUF
03BA C298            490                  CLR   RI
                     491
03BC 854483          492                  MOV   DPH,44H
03BF 854582          493                  MOV   DPL,45H
03C2 F0              494                  MOVX  @DPTR,A
03C3 E545            495                  MOV   A,45H
03C5 14              496                  DEC   A
03C6 F545            497                  MOV   45H,A
03C8 6401            498                  XRL   A,#01H
03CA 6002            499                  JZ    DISPLAY_TIME
03CC 61B5            500                  AJMP  NEW_TIME
                     501
03CE 7400            502     DISPLAY_TIME:MOV   A,#00H
03D0 906000          503                  MOV   DPTR,#6000H
03D3 F0              504                  MOVX  @DPTR,A
03D4 020328          505                  LJMP  TIME1
                     506
                     507     ;---------------------------- ENABLE DISPENSER -----------------------------
                     508
03D7 744F            509     PUMP_OFF:    MOV   A,#4FH              ;"tell cad to disp fuel disp on"
03D9 12023F          510                  LCALL TX
                     511
03DC C2D7            512     G10:         CLR   PSW.7               ;Clear carry
03DE E590            513                  MOV   A,P1                ;Retrieving
03E0 13              514                  RRC   A                   ;sensor
```

```
LOC  OBJ            LINE     SOURCE

03E1 13                                   RRC   A
03E2 40F8                                 JC    G10
03E4 C290                                 CLR   P1.0
03E6 120278                               LCALL DELAY
03E9 D2AA                                 SETB  EX1

03EB E590                    WAIT:        MOV   A,P1
03ED 13                                   RRC   A                     ;Retrieve sensor (P1.1)
03EE 13                                   RRC   A
03EF 400D                                 JC    LAB1
03F1 0203EB                               LJMP  WAIT

                             ;****************************** FUEL FLOW MONITORING **************************

03F4 0560                    INTR1:       INC   60H
03F6 E588                    CHK:         MOV   A,88H
03F8 5408                                 ANL   A,#08H
03FA B400F9                               CJNE  A,#0H,CHK
03FD 32                                   RETI

                             ;******************************************************************************

03FE D290                    LAB1:        SETB  P1.0                  ;disable pump
0400 A3                                   INC   DPTR
0401 120407                               LCALL DOWNLOAD
0404 020427                               LJMP  LAB2

                             ;-------------------------------- STORE INFO IN RAM -------------------------

0407 752F3B                  DOWNLOAD:    MOV   2FH,#3BH
040A 744C                                 MOV   A,#4CH                ;"TELL CAD TO DISPLAY
040C 12023F                               LCALL TX                    ;CALC MESSG"

040F 12041F                  A70:         LCALL RX1
0412 F0                                   MOVX  @DPTR,A
0413 A3                                   INC   DPTR
0414 E52F                                 MOV   A,2FH
0416 14                                   DEC   A
0417 6005                                 JZ    A60
0419 F52F                                 MOV   2FH,A
041B 02040F                               LJMP  A70
041E 22                      A60:         RET

041F 3098FD                  RX1:         JNB   RI,$
0422 E599                                 MOV   A,SBUF
0424 C298                                 CLR   RI
0426 22                                   RET

0427 858350                  LAB2:        MOV   50H,DPH               ;GET STORED RAM POINTER VALUE
042A 858251                               MOV   51H,DPL
042D 120433                               LCALL READ_CLK
0430 020461                               LJMP  STOP1

0433 75540D                  READ_CLK:    MOV   54H,#0DH
0436 90600E                               MOV   DPTR,#600EH
```

```
LOC  OBJ            LINE     SOURCE

0439 E0              570     READ_AGAIN:  MOVX  A,@DPTR
043A 540F            571                  ANL   A,#0FH
043C 4430            572                  ORL   A,#30H
043E C083            573                  PUSH  DPH
0440 C082            574                  PUSH  DPL
0442 855083          575                  MOV   DPH,50H
0445 855182          576                  MOV   DPL,51H
0448 F0              577                  MOVX  @DPTR,A
0449 A3              578                  INC   DPTR
044A 858350          579                  MOV   50H,DPH
044D 858251          580                  MOV   51H,DPL
0450 D082            581                  POP   DPL
0452 D083            582                  POP   DPH
0454 1582            583                  DEC   82H
0456 E554            584                  MOV   A,54H
0458 14              585                  DEC   A
0459 6005            586                  JZ    END_READ
045B F554            587                  MOV   54H,A
045D 020439          588                  LJMP  READ_AGAIN
                     589
0460 22              590     END_READ:    RET
                     591
                     592     ;------------------------------ CALCULATE FUEL CONSUMPTION -----------------
                     593
0461 752000          594     STOP1:       MOV   20H,#00H
0464 752100          595                  MOV   21H,#00H
0467 752200          596                  MOV   22H,#00H
046A 752300          597                  MOV   23H,#00H
046D 752400          598                  MOV   24H,#00H
0470 752500          599                  MOV   25H,#00H
0473 752600          600                  MOV   26H,#00H
0476 752700          601                  MOV   27H,#00H
0479 752800          602                  MOV   28H,#00H
047C 752900          603                  MOV   29H,#00H
047F 752A00          604                  MOV   2AH,#00H
0482 752B00          605                  MOV   2BH,#00H
0485 752C00          606                  MOV   2CH,#00H
0488 752D00          607                  MOV   2DH,#00H
048B 752E02          608                  MOV   2EH,#02H
                     609
048E 855083          610     B10:         MOV   DPH,50H
0491 855182          611                  MOV   DPL,51H
0494 E582            612                  MOV   A,DPL
0496 940F            613                  SUBB  A,#0FH
0498 F582            614                  MOV   DPL,A
049A E0              615                  MOVX  A,@DPTR
049B 540F            616                  ANL   A,#0FH
049D A3              617                  INC   DPTR
049E 75F064          618                  MOV   B,#64H
04A1 A4              619                  MUL   AB
04A2 F523            620                  MOV   OP_0,A
04A4 85F022          621                  MOV   OP_1,B
                     622
04A7 E0              623                  MOVX  A,@DPTR
04A8 540F            624                  ANL   A,#0FH
```

```
LOC  OBJ          SOURCE

04AA A3                              INC   DPTR
04AB 75F00A                          MOV   B,#0AH
04AE A4                              MUL   AB
04AF 3523                            ADDC  A,OP_0
04B1 F523                            MOV   OP_0,A

04B3 E0                              MOVX  A,@DPTR
04B4 540F                            ANL   A,#0FH
04B6 A3                              INC   DPTR
04B7 3523                            ADDC  A,OP_0
04B9 F523                            MOV   OP_0,A

04BB 752800                          MOV   DIV_1,#00H
04BE 856029                          MOV   DIV_0,60H                ;READ AMOUNT OF LITRES PUMPED

04C1 1204E7                          LCALL DIV_16
04C4 85272A                          MOV   SUB_3,TMP_0

04C7 EE               B20:           MOV   A,R6
04C8 75F00A                          MOV   B,#0AH
04CB A4                              MUL   AB
04CC F523                            MOV   OP_0,A
04CE 85F022                          MOV   OP_1,B
04D1 1204E7                          LCALL DIV_16
04D4 E52E                            MOV   A,2EH
04D6 14                              DEC   A
04D7 6008                            JZ    B30
04D9 F52E                            MOV   2EH,A
04DB 85272B                          MOV   SUB_2,TMP_0
04DE 0204C7                          LJMP  B20

04E1 85272C           B30:           MOV   SUB_1,TMP_0
04E4 02054F                          LJMP  STOP_2

                      ;--------------- This divides the 32 bit op reg by the value supplied -------

04E7 7F00             DIV_16:        MOV   R7,#0
04E9 7E00                            MOV   R6,#0
04EB 752700                          MOV   TMP_0,#0
04EE 752600                          MOV   TMP_1,#0
04F1 752500                          MOV   TMP_2,#0
04F4 752400                          MOV   TMP_3,#0
04F7 A928                            MOV   R1,DIV_1
04F9 A829                            MOV   R0,DIV_0
04FB 7D20                            MOV   R5,#20H

                      ;---------------------- This begins the loop ----------------------------

04FD 120524           DIV_LOOP:      LCALL SHIFT_D
0500 EE                              MOV   A,R6
0501 33                              RLC   A
0502 FE                              MOV   R6,A
0503 EF                              MOV   A,R7
0504 33                              RLC   A
0505 FF                              MOV   R7,A
```

```
LOC  OBJ            LINE     SOURCE

                     680
0506 C3              681                CLR   C
                     682
0507 EF              683                MOV   A,R7
0508 99              684                SUBB  A,R1
0509 4012            685                JC    CANT_SUB
                     686
050B 7005            687                JNZ   CAN_SUB
                     688
050D C3              689                CLR   C
050E EE              690                MOV   A,R6
050F 98              691                SUBB  A,R0
0510 400B            692                JC    CANT_SUB
                     693
0512 C3              694     CAN_SUB:   CLR   C
0513 EE              695                MOV   A,R6
0514 98              696                SUBB  A,R0
0515 FE              697                MOV   R6,A
0516 EF              698                MOV   A,R7
0517 99              699                SUBB  A,R1
0518 FF              700                MOV   R7,A
0519 D3              701                SETB  C
051A 02051E          702                LJMP  QUOT
                     703
051D C3              704     CANT_SUB:  CLR   C
                     705
051E 12053A          706     QUOT:      LCALL SHIFT_Q
0521 DDDA            707                DJNZ  R5,DIV_LOOP
0523 22              708                RET
                     709
0524 C3              710     SHIFT_D:   CLR   C
0525 E523            711                MOV   A,OP_0
0527 33              712                RLC   A
0528 F523            713                MOV   OP_0,A
052A E522            714                MOV   A,OP_1
052C 33              715                RLC   A
052D F522            716                MOV   OP_1,A
052F E521            717                MOV   A,OP_2
0531 33              718                RLC   A
0532 F521            719                MOV   OP_2,A
0534 E520            720                MOV   A,OP_3
0536 33              721                RLC   A
0537 F520            722                MOV   OP_3,A
0539 22              723                RET
                     724
053A E527            725     SHIFT_Q:   MOV   A,TMP_0
053C 33              726                RLC   A
053D F527            727                MOV   TMP_0,A
053F E526            728                MOV   A,TMP_1
0541 33              729                RLC   A
0542 F526            730                MOV   TMP_1,A
0544 E525            731                MOV   A,TMP_2
0546 33              732                RLC   A
0547 F525            733                MOV   TMP_2,A
0549 E524            734                MOV   A,TMP_3
```

```
LOC  OBJ            LINE     SOURCE

054B 33              735                 RLC   A
054C F524            736                 MOV   TMP_3,A
054E 22              737                 RET
                     738
054F 120278          739     STOP_2:     LCALL DELAY
                     740
0552 855083          741                 MOV   DPH,50H
0555 855182          742                 MOV   DPL,51H
0558 E52A            743                 MOV   A,2AH
055A 120587          744                 LCALL HEX_ASCII
055D F0              745                 MOVX  @DPTR,A                  ;WRITE FUEL CONSUMP TO RAM
055E A3              746                 INC   DPTR                     ;"31"
055F 12023F          747                 LCALL TX
                     748
0562 E5F0            749                 MOV   A,0F0H
0564 2430            750                 ADD   A,#30H
0566 F0              751                 MOVX  @DPTR,A                  ;"31"
0567 A3              752                 INC   DPTR
0568 12023F          753                 LCALL TX
                     754
056B 742E            755                 MOV   A,#2EH
056D F0              756                 MOVX  @DPTR,A                  ;"."
056E A3              757                 INC   DPTR
056F 12023F          758                 LCALL TX
                     759
0572 E52B            760                 MOV   A,2BH
0574 2430            761                 ADD   A,#30H
0576 F0              762                 MOVX  @DPTR,A                  ;"34"
0577 A3              763                 INC   DPTR
0578 12023F          764                 LCALL TX
                     765
057B E52C            766                 MOV   A,2CH
057D 2430            767                 ADD   A,#30H
057F F0              768                 MOVX  @DPTR,A                  ;"38"
0580 A3              769                 INC   DPTR
0581 12023F          770                 LCALL TX
0584 02058E          771                 LJMP  WRITE_LIT
                     772
0587 75F00A          773     HEX_ASCII:  MOV   B,#0AH
058A 84              774                 DIV   AB
058B 2430            775                 ADD   A,#30H
058D 22              776                 RET
                     777
058E E560            778     WRITE_LIT:  MOV   A,60H
0590 120587          779                 LCALL HEX_ASCII
0593 F0              780                 MOVX  @DPTR,A
0594 A3              781                 INC   DPTR
0595 E5F0            782                 MOV   A,0F0H
0597 2430            783                 ADD   A,#30H
0599 F0              784                 MOVX  @DPTR,A
059A A3              785                 INC   DPTR
059B 0205A0          786                 LJMP  WRITE_LOC
                     787
059E F0              788                 MOVX  @DPTR,A                  ;WRITE LITRES PUMPED TO RAM
059F A3              789                 INC   DPTR
```

```
LOC  OBJ            LINE     SOURCE

                     790
05A0 7457            791     WRITE_LOC:    MOV   A,#57H                     ;"W"
05A2 F0              792                   MOVX  @DPTR,A
05A3 A3              793                   INC   DPTR
05A4 744F            794                   MOV   A,#4FH                     ;"O"
05A6 F0              795                   MOVX  @DPTR,A
05A7 A3              796                   INC   DPTR
05A8 7443            797                   MOV   A,#43H                     ;"C"
05AA F0              798                   MOVX  @DPTR,A
                     799
05AB 0568            800                   INC   68H                        ;CHECK IF RAM
05AD E568            801                   MOV   A,68H                      ;
05AF 646B            802                   XRL   A,#6BH                     ;IS FULL 6BH = 107 DRIVER'S INFO
05B1 6009            803                   JZ    DIALING                    ;
05B3 858350          804                   MOV   50H,DPH
05B6 858251          805                   MOV   51H,DPL
05B9 0206BA          806                   LJMP  RETURN
                     807
05BC 1205C5          808     DIALING:      LCALL AUTODIAL
05BF 12064A          809                   LCALL DWNLD
05C2 0206A7          810                   LJMP  RESET_CNTR
                     811
                     812     ;========================= DIALING HOST TO CONNECT =======================
                     813
05C5 D292            814     AUTODIAL:     SETB  P1.2                       ;Disable dialer
05C7 858350          815                   MOV   50H,DPH                    ;Store RAM pointer
05CA 858251          816                   MOV   51H,DPL                    ;current position
                     817
05CD C293            818     PULSE_AGAIN: CLR    P1.3                       ;Disconnect modem from line
05CF 120278          819                   LCALL DELAY
05D2 C292            820                   CLR   P1.2                       ;Reset dialer
05D4 120278          821                   LCALL DELAY
                     822
                     823     ;              MOV   A,#0AH                    ;Dial '0' for o/g line
05D7 903FF0          824                   MOV   DPTR,#3FF0H                ;Lookup tel no
                     825     ;              LJMP  PULSE
                     826
05DA E4              827     Q0:           CLR   A                          ;in RAM
05DB E0              828                   MOVX  A,@DPTR
05DC A3              829                   INC   DPTR
05DD B453FA          830                   CJNE  A,#53H,Q0
05E0 E0              831     Q10:          MOVX  A,@DPTR
05E1 A3              832                   INC   DPTR
05E2 B44503          833                   CJNE  A,#45H,Q24
05E5 020630          834                   LJMP  STOP_PULSER
                     835
05E8 540F            836     Q24:          ANL   A,#0FH
                     837
05EA C292            838     Q23:          CLR   P1.2
05EC 020613          839                   LJMP  PULSE
05EF 14              840     Q20:          DEC   A
05F0 6003            841                   JZ    FIRST
05F2 0205EA          842                   LJMP   Q23
                     843
05F5 D292            844     FIRST:        SETB  P1.2
```

```
LOC  OBJ           LINE     SOURCE

05F7 7A31           845                  MOV   R2,#31H
05F9 120624         846                  LCALL TEMPO
05FC 7AFF           847                  MOV   R2,#0FFH
05FE 120624         848                  LCALL TEMPO
0601 7AFF           849                  MOV   R2,#0FFH
0603 120624         850                  LCALL TEMPO
0606 7AFF           851                  MOV   R2,#0FFH
0608 120624         852                  LCALL TEMPO
060B 7AC9           853                  MOV   R2,#0C9H
060D 120624         854                  LCALL TEMPO
0610 0205E0         855                  LJMP  Q10
                    856
0613 D292           857     PULSE:       SETB  P1.2
0615 7A31           858                  MOV   R2,#31H                 ;33.3 ms MAKE
0617 120624         859                  LCALL  TEMPO
                    860
061A C292           861                  CLR   P1.2
061C 7A45           862                  MOV   R2,#45H                 ;66.6 ms BREAK
061E 120624         863                  LCALL  TEMPO
0621 0205EF         864                  LJMP  Q20
                    865
0624 C0E0           866     TEMPO:       PUSH  ACC
0626 74FF           867     MORE:        MOV   A,#0FFH
0628 14             868     PAUSE1:      DEC   A
0629 70FD           869                  JNZ   PAUSE1
062B DAF9           870                  DJNZ  R2,MORE
062D D0E0           871                  POP   ACC
062F 22             872                  RET
                    873
0630 D292           874     STOP_PULSER: SETB  P1.2                    ;Disable dialer
0632 120278         875                  LCALL DELAY                   ;Initalise call / waiting for
0635 120278         876                  LCALL DELAY                   ;remote modem to auto answer
0638 C292           877                  CLR   P1.2                    ;Reset dialer
063A D293           878                  SETB  P1.3                    ;Connect modem to line
                    879
063C 7F40           880                  MOV   R7,#40H
063E 120278         881     DELAY_AGAIN: LCALL DELAY
0641 EF             882                  MOV   A,R7
0642 14             883                  DEC   A
0643 6004           884                  JZ    EXIT_DIALER
0645 FF             885                  MOV   R7,A
0646 02063E         886                  LJMP  DELAY_AGAIN
                    887
0649 22             888     EXIT_DIALER: RET
                    889
                    890     ;====================== DOWNLOADING DATA STORED IN XRAM ====================
                    891
064A 7444           892     DWNLD:       MOV   A,#44H
064C 12023F         893                  LCALL TX                      ;Indicating downld to cad
                    894
064F 7402           895                  MOV   A,#02H
0651 904000         896                  MOV   DPTR,#4000H
0654 F0             897                  MOVX  @DPTR,A                 ;send STX char
                    898
0655 904001         899                  MOV   DPTR,#4001H
```

```
LOC  OBJ            LINE     SOURCE

0658 E0                      CHK_RDY:     MOVX  A,@DPTR                ;TEST IF
0659 5401                                 ANL   A,#00000001B           ;TXRDY IS SET
065B 60FB                                 JZ    CHK_RDY

065D D2D5                                 SETB  PSW.5                  ;Indicating line seized.
065F 902010                               MOV   DPTR,#2010H
0662 E0                                   MOVX  A,@DPTR
0663 A3                                   INC   DPTR
0664 858358                               MOV   58H,DPH
0667 858259                               MOV   59H,DPL
066A 904000                  MESSAGE:     MOV   DPTR,#4000H
066D F0                                   MOVX  @DPTR,A
066E 855883                               MOV   DPH,58H
0671 855982                               MOV   DPL,59H
0674 E0                                   MOVX  A,@DPTR
0675 A3                                   INC   DPTR
0676 C0E0                                 PUSH  ACC
0678 E558                                 MOV   A,58H
067A 6422                                 XRL   A,#22H                 ;rem just testing
067C 7012                                 JNZ   VERBY
067E D0E0                                 POP   ACC
0680 E559                                 MOV   A,59H
0682 6400                                 XRL   A,#00H                 ;rem just testing
0684 6003                                 JZ    EXIT_DWNLD
0686 020690                               LJMP  VERBY

0689 904000                  EXIT_DWNLD:  MOV   DPTR,#4000H
068C 7403                                 MOV   A,#03H
068E F0                                   MOVX  @DPTR,A                ;send ETX char
068F 22                                   RET

0690 D0E0                    VERBY:       POP   ACC
0692 858358                               MOV   58H,DPH
0695 858259                               MOV   59H,DPL
0698 C0E0                                 PUSH  ACC

069A 904001                  LUS:         MOV   DPTR,#4001H
069D E0                                   MOVX  A,@DPTR                ;TEST IF
069E 5401                                 ANL   A,#00000001B           ;TXRDY IS SET
06A0 60F8                                 JZ    LUS
06A2 D0E0                                 POP   ACC
06A4 02066A                               LJMP  MESSAGE

                             ;=======================DISCONNECT MODEM FROM LINE =======================

06A7 C2D5                    RESET_CNTR:  CLR   PSW.5
06A9 120278                               LCALL DELAY
06AC C293                                 CLR   P1.3                   ;Disconnect modem from line
06AE 756869                               MOV   68H,#69H
06B1 90200F                               MOV   DPTR,#200FH
06B4 858350                               MOV   50H,DPH
06B7 858251                               MOV   51H,DPL


06BA 120278                  RETURN:      LCALL DELAY
```

```
LOC  OBJ            LINE     SOURCE

06BD 120278          955                  LCALL DELAY
06C0 7452            956                  MOV   A,#52H
06C2 12023F          957                  LCALL TX
                     958
06C5 C2D5            959                  CLR   PSW.5
06C7 12041F          960                  LCALL RX1
06CA 6441            961                  XRL   A,#41H
06CC 70EC            962                  JNZ   RETURN
06CE 756000          963                  MOV   60H,#00H                ;CLEAR LITRES COUNTER
06D1 855083          964                  MOV   DPH,50H
06D4 855182          965                  MOV   DPL,51H
06D7 758107          966                  MOV   SP,#07H
06DA 858350          967                  MOV   50H,DPH
06DD 858251          968                  MOV   51H,DPL
06E0 0203D7          969                  LJMP  PUMP_OFF
                     970
                     971
                     972     ;+++++++++++++++++++++++++++ POWER FAIL ROUTINE ++++++++++++++++++++++++++++
                     973
06E3 C2AF            974     FAIL:        CLR   EA
06E5 E5D0            975                  MOV   A,PSW
06E7 5420            976                  ANL   A,#20H                  ;Line seized ?
06E9 6003            977                  JZ    DIAL
06EB 0206F1          978                  LJMP  CONT_FAIL
                     979
06EE 1205C5          980     DIAL:        LCALL AUTODIAL
                     981
06F1 12064A          982     CONT_FAIL:   LCALL DWNLD
06F4 120278          983                  LCALL DELAY
06F7 7407            984                  MOV   A,#07H                  ;send BELL char
06F9 904000          985                  MOV   DPTR,#4000H
06FC F0              986                  MOVX  @DPTR,A
                     987
06FD 120278          988                  LCALL DELAY
0700 C293            989                  CLR   P1.3                    ;Disconnect modem from line
0702 7450            990                  MOV   A,#50H                  ;Indicating IDLE MODE
0704 12023F          991                  LCALL TX                      ;to CAD
                     992
0707 438701          993                  ORL   PCON,#01H               ;Invoking IDLE MODE
                     994
;++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

                     995
070A 00              996                  NOP
                     997                  END
```

```
SYMBOL TABLE LISTING
------ ----- -------


N A M E       T Y P E   V A L U E      A T T R I B U T E S

A10. . . . .  C ADDR    02B0H    A
A20. . . . .  C ADDR    0350H    A
A30. . . . .  C ADDR    0388H    A
A50. . . . .  C ADDR    03A9H    A
A60. . . . .  C ADDR    041EH    A
A70. . . . .  C ADDR    040FH    A
AA10 . . . .  C ADDR    0305H    A
ACC. . . . .  D ADDR    00E0H    A
ACCUM. . . .    REG     ACC
AGAIN. . . .  C ADDR    0145H    A
AUTODIAL . .  C ADDR    05C5H    A
B. . . . . .  D ADDR    00F0H    A
B10. . . . .  C ADDR    048EH    A
B20. . . . .  C ADDR    04C7H    A
B30. . . . .  C ADDR    04E1H    A
BEGIN. . . .  C ADDR    006CH    A
CAN_SUB. . .  C ADDR    0512H    A
CANT_SUB . .  C ADDR    051DH    A
CHK_RDY. . .  C ADDR    0658H    A
CHK. . . . .  C ADDR    03F6H    A
CLOCK_START.  C ADDR    013BH    A
CONT_FAIL. .  C ADDR    06F1H    A
CONT_INIT. .  C ADDR    00B9H    A
DAY1 . . . .  C ADDR    0255H    A
DAY2 . . . .  C ADDR    025AH    A
DAY3 . . . .  C ADDR    025FH    A
DAY4 . . . .  C ADDR    0264H    A
DAY5 . . . .  C ADDR    0269H    A
DAY6 . . . .  C ADDR    026EH    A
DAY7 . . . .  C ADDR    0273H    A
DAYS . . . .  C ADDR    019DH    A
DELAY_AGAIN.  C ADDR    063EH    A
DELAY. . . .  C ADDR    0278H    A
DIAL . . . .  C ADDR    06EEH    A
DIALING. . .  C ADDR    05BCH    A
DISPENSER. .    ----    ----
DISPLAY_TIME  C ADDR    03CEH    A
DIV_0. . . .  D ADDR    0029H    A
DIV_1. . . .  D ADDR    0028H    A
DIV_16 . . .  C ADDR    04E7H    A
DIV_LOOP . .  C ADDR    04FDH    A
DOWNLOAD . .  C ADDR    0407H    A
DPH. . . . .  D ADDR    0083H    A
DPL. . . . .  D ADDR    0082H    A
DWNLD. . . .  C ADDR    064AH    A
EA . . . . .  B ADDR    00A8H.7  A
END_READ . .  C ADDR    0460H    A
EX0. . . . .  B ADDR    00A8H.0  A
EX1. . . . .  B ADDR    00A8H.2  A
EXIT_DIALER.  C ADDR    0649H    A
EXIT_DWNLD .  C ADDR    0689H    A
```

```
N A M E        T Y P E   V A L U E       A T T R I B U T E S

EXIT . . . .  C ADDR    01F8H    A
FAIL . . . .  C ADDR    06E3H    A
FINISH . . .  C ADDR    02E1H    A
FIRST. . . .  C ADDR    05F5H    A
G10. . . . .  C ADDR    03DCH    A
HEX_ASCII. .  C ADDR    0587H    A
INIT . . . .  C ADDR    0030H    A
INTR1. . . .  C ADDR    03F4H    A
IT0. . . . .  B ADDR    0088H.0  A
IT1. . . . .  B ADDR    0088H.2  A
LAB1 . . . .  C ADDR    03FEH    A
LAB2 . . . .  C ADDR    0427H    A
LOAD_REGS. .  C ADDR    0123H    A
LOOK_DIGIT .  C ADDR    00BCH    A
LOOP . . . .  C ADDR    027CH    A
LUS. . . . .  C ADDR    069AH    A
MES1 . . . .  C ADDR    0286H    A
MESSAGE. . .  C ADDR    066AH    A
MORE . . . .  C ADDR    0626H    A
NEW_TIME . .  C ADDR    03B5H    A
NEXT_CHR . .  C ADDR    006FH    A
OP_0 . . . .  D ADDR    0023H    A
OP_1 . . . .  D ADDR    0022H    A
OP_2 . . . .  D ADDR    0021H    A
OP_3 . . . .  D ADDR    0020H    A
P1 . . . . .  D ADDR    0090H    A
P3 . . . . .  D ADDR    00B0H    A
PAUSE. . . .  C ADDR    027EH    A
PAUSE1 . . .  C ADDR    0628H    A
PCON . . . .  D ADDR    0087H    A
PSW. . . . .  D ADDR    00D0H    A
PULSE_AGAIN.  C ADDR    05CDH    A
PULSE. . . .  C ADDR    0613H    A
PUMP_OFF . .  C ADDR    03D7H    A
PX0. . . . .  B ADDR    00B8H.0  A
Q0 . . . . .  C ADDR    050AH    A
Q10. . . . .  C ADDR    05E0H    A
Q20. . . . .  C ADDR    05EFH    A
Q23. . . . .  C ADDR    05EAH    A
Q24. . . . .  C ADDR    05E8H    A
QUOT . . . .  C ADDR    051EH    A
READ_AGAIN .  C ADDR    0439H    A
READ_CLK . .  C ADDR    0433H    A
READ . . . .  C ADDR    0141H    A
READ2. . . .  C ADDR    034CH    A
RECEIVE. . .  C ADDR    02ECH    A
RECV . . . .  C ADDR    00CBH    A
RESET_CNTR .  C ADDR    06A7H    A
RESET_DPTRS.  C ADDR    0225H    A
RETURN . . .  C ADDR    06BAH    A
RI . . . . .  B ADDR    0098H.0  A
RX . . . . .  C ADDR    00D3H    A
RX1. . . . .  C ADDR    041FH    A
SBUF . . . .  D ADDR    0099H    A
SCON . . . .  D ADDR    0098H    A
```

```
N A M E       T Y P E   V A L U E      A T T R I B U T E S

SET_DATE . .  C ADDR    0292H    A
SHIFT_D. . .  C ADDR    0524H    A
SHIFT_Q. . .  C ADDR    053AH    A
SP . . . . .  D ADDR    0081H    A
STOP_2 . . .  C ADDR    054FH    A
STOP_PULSER.  C ADDR    0630H    A
STOP . . . .  C ADDR    0393H    A
STOP1. . . .  C ADDR    0461H    A
STORE_DIGIT.  C ADDR    00C6H    A
SUB_0. . . .  D ADDR    002DH    A
SUB_1. . . .  D ADDR    002CH    A
SUB_2. . . .  D ADDR    002BH    A
SUB_3. . . .  D ADDR    002AH    A
TEMPO. . . .  C ADDR    0624H    A
TH1. . . . .  D ADDR    008DH    A
TI . . . . .  B ADDR    0098H.1  A
TIME . . . .  C ADDR    0247H    A
TIME1. . . .  C ADDR    0328H    A
TL1. . . . .  D ADDR    008BH    A
TMOD . . . .  D ADDR    0089H    A
TMP_0. . . .  D ADDR    0027H    A
TMP_1. . . .  D ADDR    0026H    A
TMP_2. . . .  D ADDR    0025H    A
TMP_3. . . .  D ADDR    0024H    A
TR1. . . . .  B ADDR    0088H.6  A
TST. . . . .  C ADDR    007AH    A
TX . . . . .  C ADDR    023FH    A
TXRDY. . . .  C ADDR    0083H    A
TYD. . . . .  C ADDR    01C0H    A
USATX. . . .  C ADDR    008DH    A
VERBY. . . .  C ADDR    0690H    A
WAIT . . . .  C ADDR    03EBH    A
WEER . . . .  C ADDR    0218H    A
WRITE_DATE .  C ADDR    02B6H    A
WRITE_LIT. .  C ADDR    058EH    A
WRITE_LOC. .  C ADDR    05A0H    A


REGISTER BANK(S) USED: 0

ASSEMBLY COMPLETE, 0 ERRORS FOUND
```

```
DOS 3.30 (038-N) MCS-51 MACRO ASSEMBLER, V2.2
OBJECT MODULE PLACED IN CP8.OBJ
ASSEMBLER INVOKED BY:  C:\PRODISK\SCRATCH\ASM51.EXE CP8.ASM

LOC  OBJ            LINE     SOURCE
                       1     NAME    FUEL_DISPENSER      ;24 September 1990 FUEL PUMP ON/OFF CONTROL
                       2     ;
                       3     ;
                       4     PUBLIC APPLI,S_CARD_REMOVED,ITIMER0,S_COPY_MSG_BAT,STACK,BFCP8,LCD_PTR
                       5     PUBLIC  BAT_FAILURE_MSG
                       6     ;
                       7     EXTRN   CODE (HALT,FIN,TEMPO,S_CARD_DRIVER_1,S_LCD_CHX_PTR,S_LCD_CHAR_OUT)
                       8     EXTRN   CODE (S_LCD_MSGC_OUT,S_LCD_MSGX_OUT,S_BLANK_LCD,
                                           S_KEY_IN,S_KEY_RELEASE)
                       9     ;
                      10     ;-----------------------------------------------------------------------
                      11     ;
                      12     XSEG    AT     8000H                                ;EXTERNAL RAM
                      13     ;
8000                  14     BAT_FAILURE_MSG:     DS      35                     ;Used by AKL200 library
8023                  15     BFCP8:               DS      16                     ;Used by AKL200 test prog
8033                  16     LCD_PTR:             DS      1                      ;Current lcd ptr position
8034                  17     CARD_IN:             DS      20                     ;Buffer to card
8048                  18     CARD_OUT:            DS      20                     ;Buffer from card
805C                  19     DATE:                DS      12                     ;Date buffer
8068                  20     TEMP_PIN:            DS      20                     ;Pin code buffer
807C                  21     SYS_PASS:            DS      6                      ;System pass buffer
8082                  22     TRANSACT:            DS      4000H                  ;Transaction storage
C082                  23     COUNT:               DS      1                      ;Pin access counter
C083                  24     DUMMY_RX:            DS      1                      ;Invalid character buffer
C084                  25     TRAVELLED:           DS      6                      ;Km travelled buffer
C08A                  26     AVERAGE:             DS      5                      ;Fuel consumed buffer
C08F                  27     ODO:                 DS      8                      ;Odo reading buffer
C097                  28     ODO_LOW_BYTE:        DS      4                      ;Lower nibble buffer
C09B                  29     CONSUMPTION:         DS      4                      ;Fuel consumed buffer
C09F                  30     TEL:                 DS      20                     ;Telephone buffer
                      31     ;
                      32     ;-----------------------------------------------------------------------
                      33     ;
                      34     IN_AREA       SEGMENT  IDATA                        ;Internal RAM
                      35     ;
                      36     RSEG          IN_AREA
0000                  37     STACK:               DS      64                     ;Set STACK size
                      38     ;
                      39
                             ;-----------------------------------------------------------------------
                      40     ;
                      41     CSEG  AT  1500H
                      42     ;
1500 2A465545         43     FUEL:          DB    '*FUEL DISPENSER*',0DH,0AH,'*  CONTROLLER  *',0CH


1504 4C204449
1508 5350454E
150C 5345522A
1510 0D
1511 0A
1512 2A202043
1516 4F4E5452
```

```
LOC  OBJ            LINE     SOURCE

151A 4F4C4C45
151E 5220202A
1522 0C
1523 41434345         44     ACCESS:         DB     'ACCESS  TRACKING',0DH,0AH,'ZONE FULL (CARD)',0CH
1527 53532020
152B 54524143
152F 4B494E47
1533 0D
1534 0A
1535 5A4F4E45
1539 2046554C
153D 4C202843
1541 41524429
1545 0C
1546 20504F57         45     BATTERY:        DB     ' POWER FAILURE  ',0DH,0AH,' SYSTEM  CLOSED ',0CH
154A 45522046
154E 41494C55
1552 52452020
1556 0D
1557 0A
1558 20535953
155C 54454D20
1560 20434C4F
1564 53454420
1568 0C
1569 20504C45         46     INSERT:         DB     ' PLEASE INSERT  ',0DH,0AH,'   YOUR CARD    ',0CH
156D 41534520
1571 494E5345
1575 52542020
1579 0D
157A 0A
157B 20202059
157F 4F555220
1583 43415244
1587 20202020
158B 0C
158C 20504C45         47     REMOVE:         DB     ' PLEASE REMOVE  ',0DH,0AH,'      CARD      ',0CH
1590 41534520
1594 52454D4F
1598 56452020
159C 0D
159D 0A
159E 20202020
15A2 20204341
15A6 52442020
15AA 20202020
15AE 0C
15AF 20454E54         48     PIN:            DB     ' ENTER PIN !!!! ',0DH,0AH,0CH
15B3 45522050
15B7 494E2021
15BB 21212120
15BF 0D
15C0 0A
15C1 0C
15C2 50494E20         49     ERROR:          DB     'PIN CODE ERROR !',0DH,0AH,0CH
```

```
LOC  OBJ            LINE    SOURCE

15C6 434F4445
15CA 20455252
15CE 4F522021
15D2 0D
15D3 0A
15D4 0C
15D5 2A204341         50    LOCKED:         DB     '* CARD  LOCKED *',0DH,0AH,0CH
15D9 52442020
15DD 4C4F434B
15E1 4544202A
15E5 0D
15E6 0A
15E7 0C
15E8 2A204341         51    FAULTY:         DB     '* CARD  FAULTY *',0DH,0AH,0CH
15EC 52442020
15F0 4641554C
15F4 5459202A
15F8 0D
15F9 0A
15FA 0C
15FB 2020504C         52    WAIT:           DB     '  PLEASE  WAIT  ',0DH,0AH,0CH
15FF 45415345
1603 20205741
1607 49542020
160B 0D
160C 0A
160D 0C
160E 2A20494C         53    ILLEGAL:        DB     '* ILLEGAL CARD *',0DH,0AH,0CH
1612 4C454741
1616 4C204341
161A 5244202A
161E 0D
161F 0A
1620 0C
1621 2A204241         54    SECURITY:       DB     '* BAD SECURITY *',0DH,0AH,0CH
1625 44205345
1629 43555249
162D 5459202A
1631 0D
1632 0A
1633 0C
1634 2A2A2A20         55    GOOD_DAY:       DB     '*** Good Day ***',0DH,0AH,0CH
1638 476F6F64
163C 20446179
1640 202A2A2A

1644 0D
1645 0A
1646 0C
1647 2A               56    AST:            DB     '*',0CH
1648 0C
1649 434F4D4D         57    PORT:           DB     'COMMUNICATION ? ',0DH,0AH,0CH
164D 554E4943
1651 4154494F
1655 4E203F20
1659 0D
```

```
LOC  OBJ            LINE     SOURCE

165A 0A
165B 0C
165C 486F7065         58     DRIVE:         DB    'Hope you had a  ',0DH,0AH,'Pleasant drive !',0CH
1660 20796F75
1664 20686164
1668 20612020
166C 0D
166D 0A
166E 506C6561
1672 73616E74
1676 20647269
167A 76652021
167E 0C
167F 53455455         59     SETUP:         DB    'SETUP  PROCEDURE',0DH,0AH,'   FOLLOWING    ',0CH
1683 50202050
1687 524F4345
168B 44555245
168F 0D
1690 0A
1691 20202046
1695 4F4C4C4F
1699 57494E47
169D 20202020

16A1 0C
16A2 53595354         60     PASS:          DB    'SYSTEM  PASSWORD',0DH,0AH,0CH
16A6 454D2020
16AA 50415353
16AE 574F5244
16B2 0D
16B3 0A
16B4 0C
16B5 494C4C45         61     NO:            DB    'ILLEGAL PASSWORD',0DH,0AH,' ACCESS  DENIED ',0CH
16B9 47414C20
16BD 50415353
16C1 574F5244
16C5 0D
16C6 0A
16C7 20414343
16CB 45535320
16CF 2044454E
16D3 49454420
16D7 0C
16D8 43555252         62     CURR:          DB    'CURRENT DATE IS ',0DH,0AH,0CH
16DC 454E5420
16E0 44415445
16E4 20495320
16E8 0D
16E9 0A
16EA 0C
16EB 20454E54         63     ENTER_DATE:    DB    ' ENTER NEW DATE ',0DH,0AH,'   (YY-MM-DD)   ',0CH
16EF 4552204E
16F3 45572044
16F7 41544520
16FB 0D
16FC 0A
```

```
LOC  OBJ            LINE     SOURCE

16FD 20202028
1701 59592D4D
1705 4D2D4444
1709 29202020
170D 0C
170E 20454E54         64     DAG:            DB     ' ENTER  DAY  NR ',0DH,0AH,' 1=MON....7=SUN ',0CH
1712 45522020
1716 44415920
171A 204E5220
171E 0D
171F 0A
1720 20313D4D
1724 4F4E2E2E
1728 2E2E373D
172C 53554E20
1730 0C
1731 43555252         65     TYD:            DB     'CURRENT TIME IS ',0DH,0AH,0CH
1735 454E5420
1739 54494D45
173D 20495320
1741 0D
1742 0A
1743 0C
1744 2A2D4348         66     CHANGE:         DB     '*-CHANGE   #-ESC',0DH,0AH,0CH
1748 414E4745
174C 20202023
1750 2D455343
1754 0D
1755 0A
1756 0C
1757 454E5445         67     TIME_CHANGE:    DB     'ENTER  NEW  TIME',0DH,0AH,0CH
175B 5220204E
175F 45572020
1763 54494D45
1767 0D
1768 0A
1769 0C
176A 20456E74         68     KILO:           DB     ' Enter Odometer ',0DH,0AH,'reading  in  km ',0CH
176E 6572204F
1772 646F6D65
1776 74657220
177A 0D
177B 0A
177C 72656164
1780 696E6720
1784 20696E20
1788 206B6D20
178C 0C
178D 2A2D4368         69     LABEL1:         DB     '*-Change   #-Esc',0DH,0AH,0CH
1791 616E6765
1795 20202023
1799 2D457363
179D 0D
179E 0A
179F 0C
```

```
LOC  OBJ            LINE     SOURCE

17A0 2020202D         70     LABEL2:         DB     '   ------    km  ',0DH,0AH,0CH
17A4 2D2D2D2D
17A8 2D202020
17AC 6B6D2020
17B0 0D
17B1 0A
17B2 0C
17B3 20204361         71     LABEL3:         DB     '  Calculating   ',0DH,0AH,'Fuel consumption',0CH
17B7 6C63756C
17BB 6174696E
17BF 67202020
17C3 0D
17C4 0A
17C5 4675656C
17C9 20636F6E
17CD 73756D70
17D1 74696F6E
17D5 0C
17D6 20467565         72     LABEL5:         DB     ' Fuel Dispenser ',0DH,0AH,'** activated ** ',0CH
17DA 6C204469
17DE 7370656E
17E2 73657220
17E6 0D
17E7 0A
17E8 2A2A2061
17EC 63746976
17F0 61746564
17F4 202A2A20
17F8 0C
17F9 2B2B2044         73     LABEL6:         DB     '++ Dispensing ++',0DH,0AH,0CH
17FD 69737065
1801 6E73696E
1805 67202B2B
1809 0D
180A 0A
180B 0C
180C 506C6561         74     LABEL7:         DB     'Please take card',0DH,0AH,0CH
1810 73652074
1814 616B6520
1818 63617264
181C 0D
181D 0A
181E 0C
181F 48617665         75     LABEL8:         DB     'Have a nice day!',0DH,0AH,0CH
1823 2061206E
1827 69636520
182B 64617921
182F 0D
1830 0A
1831 0C
1832 20467565         76     LABEL9:         DB     ' Fuel  consumed ',0DH,0AH,0CH
1836 6C202063
183A 6F6E7375
183E 6D656420
1842 0D
```

```
LOC  OBJ            LINE     SOURCE

1843 0A
1844 0C
1845 20454E54         77     LABEL12:       DB    ' ENTER AUTODIAL ',0DH,0AH,'  PHONE NUMBER  ',0CH
1849 45522041
184D 55544F44
1851 49414C20
1855 0D
1856 0A
1857 20205048
185B 4F4E4520
185F 4E554D42
1863 45522020
1867 0C
1868 20202020         78     LABEL13:       DB    '                ',0DH,0AH,0CH
186C 20202020
1870 20202020
1874 20202020
1878 0D
1879 0A
187A 0C
187B 20557064         79     LABEL14:       DB    ' Updating  card ',0DH,0AH,'  information   ',0CH
187F 6174696E
1883 67202063
1887 61726420
188B 0D
188C 0A
188D 2020696E
1891 666F726D
1895 6174696F
1899 6E202020
189D 0C
189E 20496E63         80     LABEL15:       DB    ' Incorrect odo  ',0dh,0ah,'  meter  entry  ',0ch
18A2 6F727265
18A6 6374206F
18AA 646F2020
18AE 0D
18AF 0A
18B0 20206D65
18B4 74657220
18B8 20656E74
18BC 72792020
18C0 0C
18C1 20202044         81     DWNLD:         DB    '   Downloading  ',0dh,0ah,' Processed info ',0dh,0ah,0ch
18C5 6F776E6C
18C9 6F616469
18CD 6E672020
18D1 0D
18D2 0A
18D3 2050726F
18D7 63657373
18DB 65642069
18DF 6E666F20
18E3 0D
18E4 0A
18E5 0C
```

```
LOC  OBJ            LINE     SOURCE

                      82     ;
                      83     ;
18E6 32               84     ITIMERO:       RETI
                      85     ;
                      86     ;---------------------------- INITIALIZE CAD -----------------------------
                      87     ;
                      88     APPLI:
18E7 C2D4             89     APPLI1:        CLR     0D4H                ;Select RB0
18E9 C2D3             90                    CLR     0D3H                ;  "   "
                      91
18EB D2AF             92                    SETB    EA                  ;Enable all interrupts
18ED D2AA             93                    SETB    EX1                 ;Enable INT1
18EF D2B3             94                    SETB    P3.3                ;Set bit 3 of P3
18F1 C28A             95                    CLR     IT1                 ;Level activated
                      96
  0087                97                    PCON    DATA 87H            ;Define PCON address
18F3 758DFD           98                    MOV     TH1,#0FDH           ;Timer 1 reload value
18F6 758B00           99                    MOV     TL1,#000H           ;FDH = 9600 baud
18F9 53877F          100                    ANL     PCON,#7FH           ;Set timer 1 for single baud
                                                                        ;rate
18FC 758920          101                    MOV     TMOD,#20H           ;Select 8-bit Auto-reload mode
18FF 759853          102                    MOV     SCON,#53H           ;Set 8-bit UART mode, set TI/RI
1902 D28E            103                    SETB    TR1                 ;Turn timer 1 on
                     104
1904 754306          105                    MOV     43H,#06H            ;SYS_PASS length
1907 75440C          106                    MOV     44H,#0CH            ;Current_date_counter
190A 90C082          107                    MOV     DPTR,#COUNT
190D 7403            108                    MOV     A,#03H              ;Initialize pin
190F F0              109                    MOVX    @DPTR,A             ;counter
                     110
                     111     ;----------------------------- SYSTEM PASSWORD ---------------------------
                     112
1910 9016A2          113     INPUT:         MOV     DPTR,#PASS          ;"SYSTEM PASSWORD"
1913 122401          114                    LCALL   DISPLAY             ;Display
                     115
1916 90807C          116                    MOV     DPTR,#SYS_PASS      ;Load SYS_PASS address into DPTR
1919 858341          117                    MOV     41H,DPH             ;Store (DPTR) in IDATA area
191C 858242          118                    MOV     42H,DPL             ; "      "    "   "    "
                     119
191F 122409          120     BACK:          LCALL   KEYS                ;Read keypad
1922 854183          121                    MOV     DPH,41H             ;Restore contents of DPTR
1925 854282          122                    MOV     DPL,42H             ;  "         "    "   "
1928 F0              123                    MOVX    @DPTR,A             ;Write char to SYS_PASS
1929 A3              124                    INC     DPTR                ;Increment DPTR
192A 858341          125                    MOV     41H,DPH             ;Store (DPTR) in IDATA area
192D 858242          126                    MOV     42H,DPL             ; "     "    "    "    "
                     127
1930 120000     F    128     D10:           LCALL   S_KEY_RELEASE       ;Test if key is released
1933 40FB            129                    JC      D10                 ;If not test again
                     130
1935 C0E0            131                    PUSH    ACC                 ;Store ACC value on STACK
1937 E543            132                    MOV     A,43H               ;Load SYS_PASS counter into ACC
1939 14              133                    DEC     A                   ;Decrement counter
193A 6007            134                    JZ      COMPARE             ;If 0 jump to COMPARE
193C F543            135                    MOV     43H,A               ;Restore counter
193E D0E0            136                    POP     ACC                 ;Restore ACC
```

```
LOC  OBJ            LINE     SOURCE

1940 02191F          137                     LJMP   BACK                  ;Read keypad for next char
1943 90807C          139     COMPARE:        MOV    DPTR,#SYS_PASS        ;Load SYS_PASS address into DPTR
1946 E0              140                     MOVX   A,@DPTR               ;Read char from SYS_PASS
1947 6431            141                     XRL    A,#31H                ;Compare char with 31H
1949 7021            142                     JNZ    WRONG                 ;If not 0 jump WRONG
194B A3              143                     INC    DPTR
                     144
194C E0              145                     MOVX   A,@DPTR               ;Read char from SYS_PASS
194D 6433            146                     XRL    A,#33H                ;Compare char with 33H
194F 701B            147                     JNZ    WRONG                 ;If not 0 jump WRONG
1951 A3              148                     INC    DPTR                  ;Increment DPTR
                     149
1952 E0              150                     MOVX   A,@DPTR               ;Read char from SYS_PASS
1953 6430            151                     XRL    A,#30H                ;Compare char with 30H
1955 7015            152                     JNZ    WRONG                 ;If not 0 jump WRONG
1957 A3              153                     INC    DPTR                  ;Increment DPTR
                     154
1958 E0              155                     MOVX   A,@DPTR               ;Read char from SYS_PASS
1959 6436            156                     XRL    A,#36H                ;Compare char with 36H
195B 700F            157                     JNZ    WRONG                 ;If not 0 jump WRONG
195D A3              158                     INC    DPTR                  ;Increment DPTR
                     159
195E E0              160                     MOVX   A,@DPTR               ;Read char from SYS_PASS
195F 6439            161                     XRL    A,#39H                ;Compare char with 39H
1961 7009            162                     JNZ    WRONG                 ;If not 0 jump WRONG
1963 A3              163                     INC    DPTR                  ;Increment DPTR
                     164
1964 E0              165                     MOVX   A,@DPTR               ;Read char from SYS_PASS
1965 6430            166                     XRL    A,#30H                ;Compare char with 30H
1967 7003            167                     JNZ    WRONG                 ;If not 0 jump WRONG
1969 021978          168                     LJMP   PROC_SETUP            ;Jump to PROC_SETUP
                     169
196C 9016B5          170     WRONG:          MOV    DPTR,#NO              ;"ILLEGAL PASSWORD"
196F 122401          171                     LCALL  DISPLAY               ;"ACCESS DENIED"
                     172
1972 122413          173                     LCALL  PAUSE
1975 022382          174                     LJMP   STOP                  ;Jump to STOP
                     175
                     176     ;------------------------------ ENTER TELEPHONE NO ------------------------
                     177
1978 90167F          178     PROC_SETUP:     MOV    DPTR,#SETUP            ;"SETUP PROC FOLLOWING"
197B 122401          179                     LCALL  DISPLAY                ;Display
197E 122413          180                     LCALL  PAUSE
                     181
1981 901845          182                     MOV    DPTR,#LABEL12          ;"TELEPHONE NO:"
1984 122401          183                     LCALL  DISPLAY                ;Display
1987 122413          184                     LCALL  PAUSE
                     185
198A 901744          186                     MOV    DPTR,#CHANGE           ;"*-CHANGE  #-ESC"
198D 122401          187                     LCALL  DISPLAY                ;Display
                     188
1990 7440            189     W30:            MOV    A,#40H
1992 120000     F    190                     LCALL  S_LCD_CHX_PTR          ;Change LCD ptr position
```

```
LOC  OBJ            LINE     SOURCE

                     191
1995 901868          192                    MOV     DPTR,#LABEL13          ;"                 "
1998 C3              193                    CLR     C                      ;Clear carry
1999 120000     F    194                    LCALL   S_LCD_MSGC_OUT         ;Display on LCD
                     195
199C 7440            196                    MOV     A,#40H
199E 120000     F    197                    LCALL   S_LCD_CHX_PTR          ;Change LCD ptr position
                     198
19A1 90C09F          199                    MOV     DPTR,#TEL              ;Load TEL address into DPTR
19A4 7453            200                    MOV     A,#53H                 ;"S" -start
19A6 F0              201                    MOVX    @DPTR,A
19A7 A3              202                    INC     DPTR
                     203
19A8 122409          204     W20:           LCALL   KEYS                   ;Read keypad
19AB B40303          205                    CJNE    A,#03H,WRITE_TEL       ;Check if ACC = 03H (#-ESC)
19AE 0219C7          206                    LJMP    W40
                     207
19B1 B40203          208     WRITE_TEL:     CJNE    A,#02H,TST_0           ;Check if ACC = 02H (*-CHANGE)

19B4 021990          209                    LJMP    W30
19B7 B43002          210     TST_0:         CJNE    A,#30H,WRITE_DIGIT     ;If ACC = 30H then
19BA 743A            211                    MOV     A,#3AH                 ;move 3AH (":") into ACC
19BC F0              212     WRITE_DIGIT:   MOVX    @DPTR,A
19BD A3              213                    INC     DPTR
                     214
19BE 120000     F    215                    LCALL   S_LCD_CHAR_OUT         ;Display char at LCD ptr
19C1 121A52          216                    LCALL   A70
19C4 0219A8          217                    LJMP    W20
                     218
19C7 121A52          219     W40:           LCALL   A70
19CA 7445            220                    MOV     A,#45H                 ;"E" - END OF TEL NO
19CC F0              221                    MOVX    @DPTR,A
                     222
19CD 90C09F          223                    MOV     DPTR,#TEL
19D0 E0              224     NEXT_DIGIT:    MOVX    A,@DPTR
19D1 A3              225                    INC     DPTR
19D2 B44506          226                    CJNE    A,#45H,SEND_TEL        ;Check if ACC = 45H (E-
                                                                           ;END_OF_TEL)
19D5 122372          227                    LCALL   TX                     ;Transmit char in ACC
19D8 0219E4          228                    LJMP    DATE_DISPLAY
19DB 122372          229     SEND_TEL:      LCALL   TX                     ;Transmit 45H
19DE 122413          230                    LCALL   PAUSE
19E1 0219D0          231                    LJMP    NEXT_DIGIT
                     232
                     233     ;-------------------------------- SET DATE ----------------------------------
                     234
19E4 9016D8          235     DATE_DISPLAY:  MOV     DPTR,#CURR             ;"CURRENT DATE IS"
19E7 122401          236                    LCALL   DISPLAY                ;Display
                     237
19EA 7442            238                    MOV     A,#42H
19EC 120000     F    239                    LCALL   S_LCD_CHX_PTR          ;Set display ptr
                     240
19EF 7444            241                    MOV     A,#44H                 ;"D" - DATE
19F1 121B8D          242                    LCALL   TRANS                  ;Transmit "D"
                     243
19F4 12237A          244                    LCALL   NO_RX                  ;Dummy Receive
                     245
```

```
LOC  OBJ            LINE     SOURCE

19F7 121A58          246     A60:        LCALL  RX                   ;Receive char
19FA 120000     F    247                 LCALL  S_LCD_CHAR_OUT       ;Display char at LCD ptr
19FD E544            248                 MOV    A,44H                ;ACC = 0CH (date_counter)
19FF 14              249                 DEC    A
1A00 6005            250                 JZ     DAY
1A02 F544            251                 MOV    44H,A
1A04 0219F7          252                 LJMP   A60
                     253
1A07 122413          254     DAY:        LCALL  PAUSE
1A0A 90170E          255                 MOV    DPTR,#DAG            ;"ENTER DAY 1 ETC"
1A0D 122401          256                 LCALL  DISPLAY              ;Display
                     257
1A10 122409          258     A210:       LCALL  KEYS                 ;Read keypad
1A13 121B8D          259                 LCALL  TRANS                ;Transmit char entered on
                                                                     ;keypad
1A16 120000     F    260     A220:       LCALL  S_KEY_RELEASE        ;Check if key is released
1A19 40FB            261                 JC     A220
                     262
1A1B 9016EB          263     NEW_DATE:   MOV    DPTR,#ENTER_DATE     ;"ENTER NEW DATE"
1A1E 122401          264                 LCALL  DISPLAY              ;"(YY-MM-DD)"
                     265
1A21 7444            266                 MOV    A,#44H
1A23 120000     F    267                 LCALL  S_LCD_CHX_PTR        ;Set LCD ptr
                     268
1A26 121A45          269                 LCALL  A90
1A29 121A45          270                 LCALL  A90
                     271
1A2C 7447            272                 MOV    A,#47H
1A2E 120000     F    273                 LCALL  S_LCD_CHX_PTR        ;Set LCD ptr
                     274
1A31 121A45          275                 LCALL  A90
1A34 121A45          276                 LCALL  A90
                     277
1A37 744A            278                 MOV    A,#4AH
1A39 120000     F    279                 LCALL  S_LCD_CHX_PTR        ;Set LCD ptr
                     280
1A3C 121A45          281                 LCALL  A90
1A3F 121A45          282                 LCALL  A90
1A42 121A60          283                 LCALL  A100
                     284
1A45 122409          285     A90:        LCALL  KEYS                 ;SUBROUTINE:
1A48 C0E0            286                 PUSH   ACC                  ;
1A4A 120000     F    287                 LCALL  S_LCD_CHAR_OUT       ;Display char at LCD ptr
1A4D D0E0            288                 POP    ACC                  ;
1A4F 121B8D          289                 LCALL  TRANS                ;Transmit char entered on
                                                                     ;keypad
                     290
1A52 120000     F    291     A70:        LCALL  S_KEY_RELEASE        ;
1A55 40FB            292                 JC     A70                  ;Check if key released
1A57 22              293                 RET                         ;RETURN
                     294
1A58 3098FD          295     RX:         JNB    RI,$                 ;SUBROUTINE:
1A58 E599            296                 MOV    A,SBUF               ;Receive char
1A5D C298            297                 CLR    RI
1A5F 22              298                 RET                         ;RETURN
                     299
```

```
LOC  OBJ            LINE     SOURCE
                             ;---------------------------- DISPLY DATE -------------------------------

1A60 75440C          301     A100:          MOV    44H,#0CH              ;Date_length_counter
1A63 754508          302                    MOV    45H,#08H              ;Time_length_counter
                     303
1A66 12237A          304                    LCALL  NO_RX                 ;Dummy receive
                     305
1A69 7442            306     A110:          MOV    A,#42H
1A6B 120000     F    307                    LCALL  S_LCD_CHX_PTR         ;Set LCD ptr
1A6E 121A58          308                    LCALL  RX                    ;Receive char
                     309
1A71 120000     F    310     A115:          LCALL  S_LCD_CHAR_OUT        ;
1A74 E544            311                    MOV    A,44H                 ;
1A76 14              312                    DEC    A                     ;Display
1A77 6007            313                    JZ     DISPLAY_TIME          ;new date
1A79 F544            314                    MOV    44H,A                 ;
1A7B 121A58          315                    LCALL  RX                    ;
1A7E 80F1            316                    JMP    A115                  ;
                     317
1A80 122413          318     DISPLAY_TIME:  LCALL  PAUSE
                     319
1A83 7400            320                    MOV    A,#00H                ;Display pointer
1A85 120000     F    321                    LCALL  S_LCD_CHX_PTR         ;on 1st line
                     322
1A88 901744          323                    MOV    DPTR,#CHANGE          ;"*-CHANGE  #-ESC"
1A8B C3              324                    CLR    C                     ;Clear carry
1A8C 120000     F    325                    LCALL  S_LCD_MSGC_OUT        ;Display chars on LCD
                     326
1A8F 122409          327     T20:           LCALL  KEYS                  ;Read keypad
1A92 C0E0            328                    PUSH   ACC
1A94 6402            329                    XRL    A,#02H                ;"*-CORRECT"
1A96 600D            330                    JZ     T30
1A98 D0E0            331                    POP    ACC
1A9A C0E0            332                    PUSH   ACC
1A9C 6403            333                    XRL    A,#03H                ;"#-ESC"
1A9E 6010            334                    JZ     T40
1AA0 D0E0            335                    POP    ACC
1AA2 021A8F          336                    LJMP   T20
                     337
1AA5 D0E0            338     T30:           POP    ACC
1AA7 121A52          339                    LCALL  A70
1AAA 75440C          340                    MOV    44H,#0CH              ;Date counter
1AAD 0219E4          341                    LJMP   DATE_DISPLAY
                     342
                     343     ;------------------------------------ SET TIME ---------------------------
                     344
1AB0 D0E0            345     T40:           POP    ACC
1AB2 121A52          346                    LCALL  A70
1AB5 901731          347                    MOV    DPTR,#TYD             ;"CURRENT TIME IS"
1AB8 122401          348                    LCALL  DISPLAY               ;Display
                     349
1ABB 7444            350                    MOV    A,#44H
1ABD 120000     F    351                    LCALL  S_LCD_CHX_PTR         ;Set LCD ptr
                     352
1AC0 7454            353                    MOV    A,#54H                ;"T" TO uP
1AC2 121B8D          354                    LCALL  TRANS                 ;
                     355
```

```
LOC  OBJ            LINE     SOURCE

1AC5 12237A          356                  LCALL  NO_RX              ;Dummy receive
                     357
1AC8 121A58          358     A120:        LCALL  RX
1ACB 120000     F    359                  LCALL  S_LCD_CHAR_OUT     ;Display char at LCD ptr
1ACE E545            360                  MOV    A,45H              ;
1AD0 14              361                  DEC    A                  ;Read time
1AD1 6004            362                  JZ     NEW_TIME           ;
1AD3 F545            363                  MOV    45H,A              ;
1AD5 80F1            364                  JMP    A120               ;
                     365
1AD7 122413          366     NEW_TIME:    LCALL  PAUSE
1ADA 7400            367                  MOV    A,#00H
1ADC 120000     F    368                  LCALL  S_LCD_CHX_PTR      ;Set LCD ptr on 1st line
                     369
1ADF 901744          370                  MOV    DPTR,#CHANGE       ;"*-CHANGE #-ESC"
1AE2 C3              371                  CLR    C                  ;Clear carry
1AE3 120000     F    372                  LCALL  S_LCD_MSGC_OUT     ;Display char on LCD
                     373
1AE6 122409          374     A140:        LCALL  KEYS               ;Read keypad
1AE9 C0E0            375                  PUSH   ACC
1AEB 6402            376                  XRL    A,#02H             ;02H = (*-CHANGE)
1AED 600C            377                  JZ     CHG
1AEF D0E0            378                  POP    ACC
1AF1 6403            379                  XRL    A,#03H             ;03H = (#-ESC)
1AF3 6003            380                  JZ     A135
1AF5 021AE6          381                  LJMP   A140
                     382
1AF8 021B73          383     A135:        LJMP   A150
                     384
1AFB 7443            385     CHG:         MOV    A,#43H
1AFD 122372          386                  LCALL  TX                 ;Transmit "C" to uP
                     387
1B00 120000     F    388                  LCALL  S_KEY_RELEASE      ;Check for key release
1B03 40F6            389                  JC     CHG
                     390
1B05 7400            391     A160:        MOV    A,#00H
1B07 120000     F    392                  LCALL  S_LCD_CHX_PTR      ;Set LCD ptr to 1st line
                     393
1B0A 901757          394                  MOV    DPTR,#TIME_CHANGE  ;"ENTER NEW TIME"
1B0D C3              395                  CLR    C                  ;Clear carry
1B0E 120000     F    396                  LCALL  S_LCD_MSGC_OUT     ;Display on LCD
                     397
1B11 7444            398                  MOV    A,#44H
1B13 120000     F    399                  LCALL  S_LCD_CHX_PTR      ;Set LCD ptr
                     400
1B16 121A45          401                  LCALL  A90
1B19 121A45          402                  LCALL  A90
                     403
1B1C 7447            404                  MOV    A,#47H
1B1E 120000     F    405                  LCALL  S_LCD_CHX_PTR      ;Set LCD ptr
                     406
1B21 121A45          407                  LCALL  A90
1B24 121A45          408                  LCALL  A90
                     409
1B27 744A            410                  MOV    A,#4AH
```

```
LOC  OBJ            LINE     SOURCE

1B29 120000    F     411                   LCALL  S_LCD_CHX_PTR          ;Set LCD ptr
                     412
1B2C 121A45          413                   LCALL  A90
1B2F 121A45          414                   LCALL  A90
                     415
1B32 754508          416     A320:         MOV    45H,#08H
1B35 12237A          417                   LCALL  NO_RX                  ;Dummy receive
                     418
1B38 7444            419                   MOV    A,#44H
1B3A 120000    F     420                   LCALL  S_LCD_CHX_PTR          ;Set LCD ptr
1B3D 121A58          421                   LCALL  RX
                     422
1B40 120000    F     423     A300:         LCALL  S_LCD_CHAR_OUT         ;Display char at LCD ptr
1B43 E545            424                   MOV    A,45H
1B45 14              425                   DEC    A
1B46 6007            426                   JZ     TOETS
1B48 F545            427                   MOV    45H,A
1B4A 121A58          428                   LCALL  RX
1B4D 80F1            429                   JMP    A300
                     430
1B4F 7400            431     TOETS:        MOV    A,#00H
1B51 120000    F     432                   LCALL  S_LCD_CHX_PTR          ;Set LCD ptr
                     433
1B54 901744          434                   MOV    DPTR,#CHANGE           ;"*-CHANGE  #-ESC"
1B57 C3              435                   CLR    C                      ;Clear carry
1B58 120000    F     436                   LCALL  S_LCD_MSGC_OUT         ;Display on LCD
                     437
1B5B 122409          438     A321:         LCALL  KEYS                   ;Read keypad
1B5E C0E0            439                   PUSH   ACC
1B60 6402            440                   XRL    A,#02H                 ;02H = (*-CHANGE)
1B62 6009            441                   JZ     CORR
1B64 D0E0            442                   POP    ACC
1B66 6403            443                   XRL    A,#03H                 ;03H = (#-ESC)
1B68 6009            444                   JZ     A150
1B6A 021B32          445                   LJMP   A320
                     446
1B6D 121A52          447     CORR:         LCALL  A70
1B70 021AD7          448                   LJMP   NEW_TIME
                     449
                     450     ;-------------------------------------TESTING COMMS-----------------------
                     451
1B73 120000    F     452     A150:         LCALL  S_KEY_RELEASE
1B76 40FB            453                   JC     A150
1B78 901649          454                   MOV    DPTR,#PORT             ;"COMMUNICATION ?"
1B7B 122401          455                   LCALL  DISPLAY
1B7E 122413          456                   LCALL  PAUSE
                     457
1B81 901895          458                   MOV    DPTR,#MSG              ;"TESTING THE CARDREADERS COMMS
1B84 E4              459     MESSAGE:      CLR    A                      ;PORT!!!!!!!!!!"
1B85 93              460                   MOVC   A,@A+DPTR
1B86 603A            461                   JZ     ESCAPE
1B88 718D            462                   ACALL  TRANS
1B8A A3              463                   INC    DPTR
1B8B 6184            464                   AJMP   MESSAGE
                     465
```

```
LOC  OBJ            LINE     SOURCE

1B8D C299            466     TRANS:         CLR    TI                      ;SUBROUTINE:
1B8F F599            467                    MOV    SBUF,A                  ;Transmit char
1B91 3099FD          468                    JNB    TI,$                    ;
1B94 22              469                    RET                            ;RETURN
1B95 0D              470     MSG:           DB 0DH,0AH,'TESTING THE CARDREADERS COMMS PORT!!!!!!!!',00H
1B96 0A
1B97 54455354
1B9B 494E4720
1B9F 54484520
1BA3 43415244
1BA7 52454144
1BAB 45525320
1BAF 434F4D4D
1BB3 5320504F
1BB7 52542121
1BBB 21212121
1BBF 2121
1BC1 00
1BC2 021BC5          471     ESCAPE:        LJMP   INS
                     472
                     473     ;------------------------------- AWAITING USER -----------------------------
                     474
1BC5 901500          475     INS:           MOV    DPTR,#FUEL              ;"FUEL DISP CONTROLLER"
1BC8 122401          476                    LCALL  DISPLAY                 ;Display
1BCB 122413          477                    LCALL  PAUSE
                     478
1BCE 901569          479                    MOV    DPTR,#INSERT            ;"PLSE INSERT CARD"
1BD1 122401          480                    LCALL  DISPLAY                 ;Display
1BD4 122413          481                    LCALL  PAUSE
                     482
1BD7 30B3EB          483     A40:           JNB    P3.3,INS                ;WAIT FOR INSERT CARD BIT
                     484
1BDA 9015FB          485                    MOV    DPTR,#WAIT              ;"PLSE WAIT"
1BDD 122401          486                    LCALL  DISPLAY                 ;Display
                     487
1BE0 120000     F    488                    LCALL  S_KEY_IN                ;ANY KEY PRESSED ?
1BE3 F4              489                    CPL    A                       ;Yes - JMP HALT
1BE4 6005            490                    JZ     APX                     ;NO  - CONT
1BE6 7401            491                    MOV    A,#01H
1BE8 020000     F    492                    LJMP   HALT
                     493
1BEB 796E            494     APX:           MOV    R1,#6EH                 ;POWER ON CARD
1BED 7B80            495                    MOV    R3,#HIGH(CARD_OUT)
1BEF 7C48            496                    MOV    R4,#LOW(CARD_OUT)
1BF1 120000     F    497                    LCALL  S_CARD_DRIVER_1
1BF4 5012            498                    JNC    GOOD
                     499
1BF6 9015E8          500     CARDFAULT:     MOV    DPTR,#FAULTY            ;"CARD FAULTY"
1BF9 122401          501                    LCALL  DISPLAY                 ;Display
1BFC 122413          502                    LCALL  PAUSE
                     503
1BFF 90158C          504                    MOV    DPTR,#REMOVE            ;"PLEASE REMOVE CARD"
1C02 122401          505                    LCALL  DISPLAY                 ;Display
1C05 022387          506                    LJMP   EXIT1
                     507
```

```
LOC  OBJ            LINE     SOURCE

1C08 D2D4            508     GOOD:           SETB   0D4H                 ;SELECT RB3
1C0A D2D3            509                     SETB   0D3H                 ;   "    "
1C0C EF              510                     MOV    A,R7                 ;STATUS WORD 2
1C0D C0E0            511                     PUSH   ACC
1C0F B44005          512                     CJNE   A,#40H,CMPR          ;CHECK IF CARD ARE LOCKED
1C12 D0E0            513                     POP    ACC
1C14 021C28          514                     LJMP   LOCK
                     515
1C17 D0E0            516     CMPR:           POP    ACC
1C19 B4801E          517                     CJNE   A,#80H,GOOD2         ;CHECK CARD ACCESS ZONE
1C1C 901523          518                     MOV    DPTR,#ACCESS         ;"ACCESS ZONE FULL"
1C1F 122401          519                     LCALL  DISPLAY              ;Display
1C22 122413          520                     LCALL  PAUSE
1C25 021C31          521                     LJMP   REMOVE_CARD
                     522
1C28 9015D5          523     LOCK:           MOV    DPTR,#LOCKED         ;"CARD LOCKED"
1C2B 122401          524                     LCALL  DISPLAY              ;Display
1C2E 122413          525                     LCALL  PAUSE
                     526
1C31 90158C          527     REMOVE_CARD:    MOV    DPTR,#REMOVE         ;"PLSE REMOVE CARD"
1C34 122401          528                     LCALL  DISPLAY              ;Display
1C37 022387          529                     LJMP   EXIT1
                     530
1C3A C2D4            531     GOOD2:          CLR    0D4H                 ;SELECT RB0
1C3C C2D3            532                     CLR    0D3H                 ;   "    "
1C3E 790B            533                     MOV    R1,#0DBH
1C40 7B80            534                     MOV    R3,#HIGH(CARD_OUT)
1C42 7C48            535                     MOV    R4,#LOW(CARD_OUT)
1C44 D2D4            536                     SETB   0D4H                 ;SELECT RB3
1C46 D2D3            537                     SETB   0D3H                 ;   "    "
1C48 79BC            538                     MOV    R1,#0BCH             ;BYTE CODE
1C4A 7AB0            539                     MOV    R2,#0B0H             ;READ
1C4C 7B09            540                     MOV    R3,#009H             ;ADDR HIGH
1C4E 7CD8            541                     MOV    R4,#0D8H             ;ADDR LOW
1C50 7D02            542                     MOV    R5,#002H             ;NUMBER OF BYTES
1C52 C2D4            543                     CLR    0D4H                 ;SELECT RB0
1C54 C2D3            544                     CLR    0D3H                 ;   "    "
1C56 120000     F    545                     LCALL  S_CARD_DRIVER_1
1C59 5003            546                     JNC    TEST
1C5B 021BF6          547                     LJMP   CARDFAULT
                     548
1C5E 021C88          549     TEST:           LJMP   CHK_TELE
                     550
                     551     ;----------------------------- BATTERY CHECK ROUTINE ----------------------
                     552
1C61 901546          553     S_COPY_MSG_BAT:MOV     DPTR,#BATTERY        ;"POWER FAILURE SYSTEM CLOSED"
1C64 AC82            554                     MOV    R4,DPL
1C66 AD83            555                     MOV    R5,DPH
                     556
1C68 908000          557                     MOV    DPTR,#BAT_FAILURE_MSG
1C6B AE82            558                     MOV    R6,DPL
1C6D AF83            559                     MOV    R7,DPH
                     560
1C6F 7B23            561                     MOV    R3,#35               ;35 CHAR IN TOTAL
                     562
```

```
LOC  OBJ            LINE     SOURCE

1C71 8C82            563     BAT_LOOP:      MOV    DPL,R4               ;RESTORE #BATTERY POINTER
1C73 8D83            564                    MOV    DPH,R5
1C75 7400            565                    MOV    A,#00H
1C77 93              566                    MOVC   A,@A+DPTR            ;READ FROM #BATTERY
1C78 A3              567                    INC    DPTR                 ;INC #BATTERY POINTER
1C79 AC82            568                    MOV    R4,DPL
1C7B AD83            569                    MOV    R5,DPH               ;SAVE #BATTERY POINTER
                     570
1C7D 8E82            571                    MOV    DPL,R6               ;RESTORE #MSG POINTER
1C7F 8F83            572                    MOV    DPH,R7
1C81 F0              573                    MOVX   @DPTR,A              ;COPY
1C82 A3              574                    INC    DPTR
1C83 AE82            575                    MOV    R6,DPL
1C85 AF83            576                    MOV    R7,DPH               ;SAVE #MSG POINTER
                     577
1C87 DBE8            578                    DJNZ   R3,BAT_LOOP
1C89 22              579                    RET
                     580     ;--------------------------------- CARD REMOVAL ----------------------------
1C8A 32              581     S_CARD_REMOVED:RETI
                     582
                     583     ;------------------------------VALIDATE CARD -----------------------------
                     584
1C8B 740E            585     CHK_TELE:      MOV    A,#0EH               ;SETUP TELEPASS SEED
1C8D 908034          586                    MOV    DPTR,#CARD_IN        ;CARD_IN_BUFFER address into
                                                                        ;DPTR
1C90 F0              587                    MOVX   @DPTR,A              ;READ BYTE1
1C91 A3              588                    INC    DPTR
1C92 F0              589                    MOVX   @DPTR,A              ;READ BYTE2
1C93 A3              590                    INC    DPTR
1C94 F0              591                    MOVX   @DPTR,A              ;READ BYTE3
1C95 A3              592                    INC    DPTR
1C96 F0              593                    MOVX   @DPTR,A              ;READ BYTE4
1C97 A3              594                    INC    DPTR
1C98 F0              595                    MOVX   @DPTR,A              ;READ BYTE5
1C99 A3              596                    INC    DPTR
1C9A F0              597                    MOVX   @DPTR,A              ;READ BYTE6
1C9B A3              598                    INC    DPTR
1C9C 7409            599                    MOV    A,#09H
1C9E F0              600                    MOVX   @DPTR,A              ;READ BYTE7
1C9F A3              601                    INC    DPTR
1CA0 74E8            602                    MOV    A,#0E8H
1CA2 F0              603                    MOVX   @DPTR,A              ;READ BYTE8
1CA3 79DA            604                    MOV    R1,#0DAH             ;EXECUTE TELEPASS
1CA5 7B80            605                    MOV    R3,#HIGH(CARD_IN)
1CA7 7C34            606                    MOV    R4,#LOW(CARD_IN)
1CA9 D2D4            607                    SETB   0D4H                 ;SELECT RB3
1CAB D2D3            608                    SETB   0D3H                 ;  "    "
1CAD 79BC            609                    MOV    R1,#0BCH
1CAF 7A80            610                    MOV    R2,#80H
1CB1 7B00            611                    MOV    R3,#00H
1CB3 7C00            612                    MOV    R4,#00H
1CB5 7D08            613                    MOV    R5,#08H
1CB7 C2D4            614                    CLR    0D4H                 ;SELECT RB0
1CB9 C2D3            615                    CLR    0D3H                 ;  "    "
1CBB 120000     F    616                    LCALL  S_CARD_DRIVER_1
1CBE 5003            617                    JNC    GDTELP2
```

```
LOC  OBJ            LINE     SOURCE

1CC0 021BF6          618                 LJMP    CARDFAULT             ;BAD COMPUTE ATTEMPT
                     619
1CC3 790B            620     GDTELP2:    MOV     R1,#0DBH              ;READ TELEPASS RESULT
1CC5 7B80            621                 MOV     R3,#HIGH(CARD_OUT)
1CC7 7C48            622                 MOV     R4,#LOW(CARD_OUT)
1CC9 D2D4            623                 SETB    0D4H                  ;SELECT RB3
1CCB D2D3            624                 SETB    0D3H                  ;   "    "
1CCD 79BC            625                 MOV     R1,#0BCH
1CCF 7AC0            626                 MOV     R2,#0C0H
1CD1 7B00            627                 MOV     R3,#00H
1CD3 7C00            628                 MOV     R4,#00H
1CD5 7D08            629                 MOV     R5,#08H
1CD7 C2D4            630                 CLR     0D4H                  ;SELECT RB0
1CD9 C2D3            631                 CLR     0D3H                  ;   "    "
1CDB 120000     F    632                 LCALL   S_CARD_DRIVER_1
1CDE 5003            633                 JNC     GDTELP3
1CE0 021BF6          634                 LJMP    CARDFAULT
                     635
1CE3 908048          636     GDTELP3:    MOV     DPTR,#CARD_OUT        ;CHECK TELEPASS RESULT
1CE6 E0              637                 MOVX    A,@DPTR
1CE7 6419            638                 XRL     A,#19H
1CE9 7057            639                 JNZ     BADTEL
                     640
1CEB 908048          641                 MOV     DPTR,#CARD_OUT        ;CHECK TELEPASS RESULT
1CEE A3              642                 INC     DPTR
1CEF E0              643                 MOVX    A,@DPTR
1CF0 6445            644                 XRL     A,#45H
1CF2 704E            645                 JNZ     BADTEL
                     646
1CF4 908048          647                 MOV     DPTR,#CARD_OUT        ;CHECK TELEPASS RESULT
1CF7 A3              648                 INC     DPTR
1CF8 A3              649                 INC     DPTR
1CF9 E0              650                 MOVX    A,@DPTR
1CFA 64C0            651                 XRL     A,#0C0H
1CFC 7044            652                 JNZ     BADTEL
                     653
1CFE 908048          654                 MOV     DPTR,#CARD_OUT        ;CHECK TELEPASS RESULT
1D01 A3              655                 INC     DPTR
1D02 A3              656                 INC     DPTR
1D03 A3              657                 INC     DPTR
1D04 E0              658                 MOVX    A,@DPTR
1D05 641A            659                 XRL     A,#1AH
1D07 7039            660                 JNZ     BADTEL
                     661
1D09 908048          662                 MOV     DPTR,#CARD_OUT        ;CHECK TELEPASS RESULT
1D0C A3              663                 INC     DPTR
1D0D A3              664                 INC     DPTR
1D0E A3              665                 INC     DPTR
1D0F A3              666                 INC     DPTR
1D10 E0              667                 MOVX    A,@DPTR
1D11 6428            668                 XRL     A,#28H
1D13 702D            669                 JNZ     BADTEL
                     670
1D15 908048          671                 MOV     DPTR,#CARD_OUT        ;CHECK TELEPASS RESULT
1D18 A3              672                 INC     DPTR
```

```
LOC  OBJ            LINE     SOURCE

1D19 A3              673                        INC    DPTR
1D1A A3              674                        INC    DPTR
1D1B A3              675                        INC    DPTR
1D1C A3              676                        INC    DPTR
1D1D E0              677                        MOVX   A,@DPTR
1D1E 6494            678                        XRL    A,#94H
1D20 7020            679                        JNZ    BADTEL
                     680
1D22 908048          681                        MOV    DPTR,#CARD_OUT          ;CHECK TELEPASS RESULT
1D25 A3              682                        INC    DPTR
1D26 A3              683                        INC    DPTR
1D27 A3              684                        INC    DPTR
1D28 A3              685                        INC    DPTR
1D29 A3              686                        INC    DPTR
1D2A A3              687                        INC    DPTR
1D2B E0              688                        MOVX   A,@DPTR
1D2C 6465            689                        XRL    A,#65H
1D2E 7012            690                        JNZ    BADTEL
                     691
1D30 908048          692                        MOV    DPTR,#CARD_OUT          ;CHECK TELEPASS RESULT
1D33 A3              693                        INC    DPTR
1D34 A3              694                        INC    DPTR
1D35 A3              695                        INC    DPTR
1D36 A3              696                        INC    DPTR
1D37 A3              697                        INC    DPTR
1D38 A3              698                        INC    DPTR
1D39 A3              699                        INC    DPTR
1D3A E0              700                        MOVX   A,@DPTR
1D3B 645A            701                        XRL    A,#5AH
1D3D 7003            702                        JNZ    BADTEL
1D3F 021D54          703                        LJMP   ENTER_PIN
                     704
1D42 901621          705     BADTEL:            MOV    DPTR,#SECURITY          ;CARD TELEPASS BAD
1D45 122401          706                        LCALL  DISPLAY                 ;"BAD SECURITY"
1D48 122413          707                        LCALL  PAUSE
                     708
1D4B 90158C          709                        MOV    DPTR,#REMOVE            ;"PLEASE REMOVE CARD"
1D4E 122401          710                        LCALL  DISPLAY
1D51 022387          711                        LJMP   EXIT1
                     712
                     713     ;---------------------------- ENTER PIN CODE ------------------------------
                     714
1D54 758130          715     ENTER_PIN:         MOV    SP,#30H
1D57 9015AF          716                        MOV    DPTR,#PIN               ;" ENTER PIN:"
1D5A 122401          717                        LCALL  DISPLAY
                     718
1D5D 7446            719                        MOV    A,#46H                  ;Set display ptr
1D5F 120000   F      720                        LCALL  S_LCD_CHX_PTR
                     721
1D62 755002          722                        MOV    50H,#02H                ;PIN_counter
1D65 7400            723     OUT:               MOV    A,#00H
1D67 908034          724                        MOV    DPTR,#CARD_IN
1D6A F0              725                        MOVX   @DPTR,A
1D6B A3              726                        INC    DPTR                    ;READ BYTE 1
1D6C F0              727                        MOVX   @DPTR,A
```

```
LOC  OBJ            LINE     SOURCE

1D6D A3              728               INC    DPTR                  ;READ BYTE 2
1D6E 858340          729               MOV    40H,DPH
1D71 858241          730               MOV    41H,DPL
                     731
1D74 122409          732     B20:      LCALL  KEYS
1D77 C4              733               SWAP   A                     ;Convert Chars entered
1D78 440F            734               ORL    A,#0FH                ;in the correct format
1D7A F9              735               MOV    R1,A                  ;for the Smart Card.
1D7B 121DA6          736               LCALL  B50
                     737
1D7E 122409          738     B40:      LCALL  KEYS
1D81 44F0            739               ORL    A,#0F0H               ;Convert Chars entered
1D83 59              740               ANL    A,R1                  ;in the correct format
1D84 C0E0            741               PUSH   ACC                   ;for the Smart Card.
1D86 121DA6          742               LCALL  B50
                     743
1D89 854083          744               MOV    DPH,40H
1D8C 854182          745               MOV    DPL,41H
1D8F D0E0            746               POP    ACC
1D91 F0              747               MOVX   @DPTR,A                ;READ BYTES 3&4
1D92 122372          748               LCALL  TX
1D95 A3              749               INC    DPTR
1D96 858340          750               MOV    40H,DPH
1D99 858241          751               MOV    41H,DPL
1D9C E550            752               MOV    A,50H
1D9E 14              753               DEC    A
1D9F 6010            754               JZ     GO_ON
1DA1 F550            755               MOV    50H,A
1DA3 021D74          756               LJMP   B20
                     757
1DA6 901647          758     B50:      MOV    DPTR,#AST              ;"*"
1DA9 C3              759               CLR    C
1DAA 120000     F    760               LCALL  S_LCD_MSGC_OUT         ;Display on LCD
1DAD 121A52          761               LCALL  A70
1DB0 22              762               RET
                     763
1DB1 854083          764     GO_ON:    MOV    DPH,40H
1DB4 854182          765               MOV    DPL,41H
1DB7 754D04          766               MOV    4DH,#04H
1DBA 7400            767     HERHAAL:  MOV    A,#00H
1DBC F0              768               MOVX   @DPTR,A
1DBD A3              769               INC    DPTR
1DBE E54D            770               MOV    A,4DH
1DC0 14              771               DEC    A
1DC1 6005            772               JZ     LOAD_PIN
1DC3 F54D            773               MOV    4DH,A
1DC5 021DBA          774               LJMP   HERHAAL
                     775
1DC8 C2D4            776     LOAD_PIN: CLR    0D4H
1DCA C2D3            777               CLR    0D3H
1DCC 790B            778               MOV    R1,#0DBH
1DCE 7B80            779               MOV    R3,#HIGH(TEMP_PIN)
1DD0 7C68            780               MOV    R4,#LOW(TEMP_PIN)
1DD2 D2D4            781               SETB   0D4H
1DD4 D2D3            782               SETB   0D3H
```

```
LOC  OBJ            LINE     SOURCE

1DD6 79BC            783                    MOV    R1,#0BCH
1DD8 7AB0            784                    MOV    R2,#0B0H              ;Read PIN from Smart Card
1DDA 7B02            785                    MOV    R3,#02H
1DDC 7CD0            786                    MOV    R4,#0D0H
1DDE 7D08            787                    MOV    R5,#08H
1DE0 C2D4            788                    CLR    0D4H
1DE2 C2D3            789                    CLR    0D3H
1DE4 120000     F    790                    LCALL  S_CARD_DRIVER_1
1DE7 5003            791                    JNC    X10
1DE9 0223AF          792                    LJMP   EXIT
                     793
1DEC 7405            794     X10:           MOV    A,#05H
1DEE 120000     F    795                    LCALL  TEMPO                 ;2.5sec DELAY
1DF1 796E            796                    MOV    R1,#6EH               ;POWER ON CARD
1DF3 7B80            797                    MOV    R3,#HIGH(CARD_OUT)
1DF5 7C48            798                    MOV    R4,#LOW(CARD_OUT)
1DF7 120000     F    799                    LCALL  S_CARD_DRIVER_1
1DFA 401D            800                    JC     A50
                     801
1DFC 79DA            802                    MOV    R1,#0DAH
1DFE 7B80            803                    MOV    R3,#HIGH(CARD_IN)
1E00 7C34            804                    MOV    R4,#LOW(CARD_IN)
1E02 D2D4            805                    SETB   0D4H
1E04 D2D3            806                    SETB   0D3H
1E06 79BC            807                    MOV    R1,#0BCH
1E08 7A20            808                    MOV    R2,#20H               ;Initialize Card
1E0A 7B00            809                    MOV    R3,#00H
1E0C 7C00            810                    MOV    R4,#00H
1E0E 7D08            811                    MOV    R5,#08H
1E10 C2D4            812                    CLR    0D4H
1E12 C2D3            813                    CLR    0D3H
1E14 120000     F    814                    LCALL  S_CARD_DRIVER_1
1E17 506A            815                    JNC    VALIDATE_PIN
                     816
                     817     ;-------------------------------- PIN CODE ERROR --------------------------
                     818
1E19 9015C2          819     A50:           MOV    DPTR,#ERROR           ;"PIN CODE ERROR"
1E1C 122401          820                    LCALL  DISPLAY
1E1F 122413          821                    LCALL  PAUSE
                     822
1E22 90C082          823                    MOV    DPTR,#COUNT
1E25 E0              824                    MOVX   A,@DPTR
1E26 14              825                    DEC    A
1E27 6004            826                    JZ     B100
1E29 F0              827                    MOVX   @DPTR,A
1E2A 021E30          828                    LJMP   X20
                     829
1E2D 0223AF          830     B100:          LJMP   EXIT
                     831
1E30 C2D4            832     X20:           CLR    0D4H
1E32 C2D3            833                    CLR    0D3H
1E34 79DA            834                    MOV    R1,#0DAH
1E36 7B80            835                    MOV    R3,#HIGH(TEMP_PIN)
1E38 7C68            836                    MOV    R4,#LOW(TEMP_PIN)
1E3A D2D4            837                    SETB   0D4H
```

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LOC  OBJ            LINE     SOURCE

1E3C D2D3            838                SETB   0D3H
1E3E 798C            839                MOV    R1,#0BCH
1E40 7A20            840                MOV    R2,#20H               ;Initialize Card
1E42 7B00            841                MOV    R3,#00H
1E44 7C00            842                MOV    R4,#00H
1E46 7D08            843                MOV    R5,#08H
1E48 C2D4            844                CLR    0D4H
1E4A C2D3            845                CLR    0D3H
1E4C 120000     F    846                LCALL  S_CARD_DRIVER_1
1E4F 5003            847                JNC    VAL_PASS
1E51 021E19          848                LJMP   A50
                     849
1E54 C2D4            850     VAL_PASS:  CLR    0D4H
1E56 C2D3            851                CLR    0D3H
1E58 79DA            852                MOV    R1,#0DAH
1E5A 7B80            853                MOV    R3,#HIGH(TEMP_PIN)
1E5C 7C68            854                MOV    R4,#LOW(TEMP_PIN)
1E5E D2D4            855                SETB   0D4H
1E60 D2D3            856                SETB   0D3H
1E62 79BC            857                MOV    R1,#0BCH
1E64 7A40            858                MOV    R2,#40H               ;Validation Read
1E66 7BFF            859                MOV    R3,#0FFH
1E68 7CFF            860                MOV    R4,#0FFH
1E6A 7D00            861                MOV    R5,#00H
1E6C C2D4            862                CLR    0D4H
1E6E C2D3            863                CLR    0D3H
1E70 120000     F    864                LCALL  S_CARD_DRIVER_1
1E73 5003            865                JNC    VALIDATE_PASS
1E75 021E19          866                LJMP   A50
                     867
1E78 794D            868     VALIDATE_PASS: MOV R1,#40H               ;POWER OFF CARD
1E7A 120000     F    869                LCALL  S_CARD_DRIVER_1
                     870
1E7D 758107          871                MOV    SP,#07H               ;Initialise STACK
1E80 021BEB          872                LJMP   APX                   ;Jump back to Card
                                                                     ;initialisation
                     873
                     874     ;------------------------------ VALIDATE PIN ------------------------------
                     875
1E83 D2D4            876     VALIDATE_PIN:  SETB   0D4H
1E85 D2D3            877                SETB   0D3H
1E87 E8              878                MOV    A,R0
1E88 122372          879                LCALL  TX
1E8B 6400            880                XRL    A,#00H                ;Test DRIVER STATUS
1E8D 708A            881                JNZ    A50
                     882
1E8F EF              883                MOV    A,R7
1E90 122372          884                LCALL  TX
1E93 6400            885                XRL    A,#00H                ;Test SW2 STATUS
1E95 7033            886                JNZ    A51
                     887
1E97 C2D4            888                CLR    0D4H
1E99 C2D3            889                CLR    0D3H
1E9B 790A            890                MOV    R1,#0DAH
1E9D 7B80            891                MOV    R3,#HIGH(CARD_IN)
1E9F 7C34            892                MOV    R4,#LOW(CARD_IN)
```

```
LOC  OBJ            LINE     SOURCE

1EA1 D2D4            893                    SETB   0D4H
1EA3 D2D3            894                    SETB   0D3H
1EA5 79BC            895                    MOV    R1,#0BCH
1EA7 7A40            896                    MOV    R2,#40H                 ;Validation READ
1EA9 7BFF            897                    MOV    R3,#0FFH
1EAB 7CFF            898                    MOV    R4,#0FFH
1EAD 7D00            899                    MOV    R5,#00H
1EAF C2D4            900                    CLR    0D4H
1EB1 C2D3            901                    CLR    0D3H
1EB3 120000    F     902                    LCALL  S_CARD_DRIVER_1
1EB6 5003            903                    JNC    VALIDATE_READ
1EB8 021E19          904                    LJMP   A50
                     905
1EBB D2D4            906     VALIDATE_READ: SETB   0D4H
1EBD D2D3            907                    SETB   0D3H
1EBF E8              908                    MOV    A,R0
1EC0 122372          909                    LCALL  TX
1EC3 6400            910                    XRL    A,#00H                  ;Test DRIVER STATUS
1EC5 7003            911                    JNZ    A51
1EC7 021ECD          912                    LJMP   STATUS
1ECA 021E19          913     A51:           LJMP   A50
                     914
1ECD EF              915     STATUS:        MOV    A,R7
1ECE 122372          916                    LCALL  TX
1ED1 6400            917                    XRL    A,#00H                  ;Test SW2 STATUS
1ED3 70F5            918                    JNZ    A51
                     919
1ED5 C2D4            920     PIN_CORRECT:   CLR    0D4H
1ED7 C2D3            921                    CLR    0D3H
1ED9 901634          922                    MOV    DPTR,#GOOD_DAY          ;"*** GOOD DAY ***"
1EDC 122401          923                    LCALL  DISPLAY
1EDF 122413          924                    LCALL  PAUSE
                     925
1EE2 90165C          926                    MOV    DPTR,#DRIVE             ;"HOPE YOU HAD A PLEASANT DRIVE"
1EE5 122401          927                    LCALL  DISPLAY
1EE8 122413          928                    LCALL  PAUSE
1EEB 122413          929                    LCALL  PAUSE
1EEE 90C082          930                    MOV    DPTR,#COUNT
1EF1 7402            931                    MOV    A,#02H
1EF3 F0              932                    MOVX   @DPTR,A
                     933
                     934     ;---------------------------------- ENTER ODO METER READING ---------------
                     935
1EF4 90176A          936     C20:           MOV    DPTR,#KILO              ;"Enter Odometer reading
1EF7 122401          937                    LCALL  DISPLAY                 ;in KM
1EFA 122413          938                    LCALL  PAUSE
1EFD 122413          939                    LCALL  PAUSE
                     940
1F00 90178D          941                    MOV    DPTR,#LABEL1            ;"* -Change #-Esc"
1F03 122401          942                    LCALL  DISPLAY
                     943
1F06 7440            944     B80:           MOV    A,#40H
1F08 120000    F     945                    LCALL  S_LCD_CHX_PTR
                     946
1F0B 9017A0          947                    MOV    DPTR,#LABEL2            ;" ------  km  "
```

```
LOC  OBJ          LINE     SOURCE

1F0E C3            948                 CLR    C
1F0F 120000    F   949                 LCALL  S_LCD_MSGC_OUT
                   950
1F12 754343        951     B60:        MOV    43H,#43H
1F15 90C08F        952                 MOV    DPTR,#ODO
1F18 85833B        953                 MOV    3BH,DPH
1F1B 85823C        954                 MOV    3CH,DPL
1F1E 90C097        955                 MOV    DPTR,#ODO_LOW_BYTE
1F21 85834A        956                 MOV    4AH,DPH
1F24 85824B        957                 MOV    4BH,DPL
1F27 754C04        958                 MOV    4CH,#04H
                   959
1F2A 908034        960                 MOV    DPTR,#CARD_IN
1F2D E543          961     B65:        MOV    A,43H
1F2F 120000    F   962                 LCALL  S_LCD_CHX_PTR
                   963
1F32 122409        964     B75:        LCALL  KEYS
1F35 B40303        965                 CJNE   A,#03H,WRITE_ODO        ;Blocking out Esc  char
1F38 021F6A        966                 LJMP   B70
                   967
1F3B F0            968     WRITE_ODO:  MOVX   @DPTR,A
1F3C A3            969                 INC    DPTR
1F3D C083          970                 PUSH   DPH
1F3F C082          971                 PUSH   DPL
1F41 853B83        972                 MOV    DPH,3BH
1F44 853C82        973                 MOV    DPL,3CH
1F47 F0            974                 MOVX   @DPTR,A
1F48 A3            975                 INC    DPTR
1F49 85833B        976                 MOV    3BH,DPH
1F4C 85823C        977                 MOV    3CH,DPL
1F4F D082          978                 POP    DPL
1F51 D083          979                 POP    DPH
                   980
1F53 B40203        981                 CJNE   A,#02H,NOT_EQ            ;"* -Change "
1F56 021F06        982                 LJMP   B80
                   983
1F59 B40303        984     NOT_EQ:     CJNE   A,#03H,NOT_EQ1           ;"#-Esc"
1F5C 021F6A        985                 LJMP   B70
                   986
1F5F 120000    F   987     NOT_EQ1:    LCALL  S_LCD_CHAR_OUT
1F62 121A52        988                 LCALL  A70
1F65 0543          989                 INC    43H
1F67 021F2D        990                 LJMP   B65
                   991
1F6A 7400          992     B70:        MOV    A,#00H                   ;WRITING 0'S
1F6C 853B83        993                 MOV    DPH,3BH                  ;INTO LAST 2
1F6F 853C82        994                 MOV    DPL,3CH                  ;BITS OF ODO
1F72 F0            995                 MOVX   @DPTR,A
1F73 A3            996                 INC    DPTR
1F74 F0            997                 MOVX   @DPTR,A
1F75 90C08F        998                 MOV    DPTR,#ODO
1F78 A3            999                 INC    DPTR
1F79 A3           1000                 INC    DPTR
1F7A A3           1001                 INC    DPTR
1F7B A3           1002                 INC    DPTR
```

```
LOC  OBJ            LINE     SOURCE

1F7C E0             1003     LOW_BYTE:     MOVX   A,@DPTR
1F7D A3             1004                   INC    DPTR
1F7E C083           1005                   PUSH   DPH
1F80 C082           1006                   PUSH   DPL
1F82 854A83         1007                   MOV    DPH,4AH
1F85 854B82         1008                   MOV    DPL,4BH
1F88 F0             1009                   MOVX   @DPTR,A
1F89 A3             1010                   INC    DPTR
1F8A 85834A         1011                   MOV    4AH,DPH
1F8D 85824B         1012                   MOV    4BH,DPL
1F90 D082           1013                   POP    DPL
1F92 D083           1014                   POP    DPH
1F94 E54C           1015                   MOV    A,4CH
1F96 14             1016                   DEC    A
1F97 6005           1017                   JZ     LEAVE
1F99 F54C           1018                   MOV    4CH,A
1F9B 021F7C         1019                   LJMP   LOW_BYTE
                    1020
1F9E C2D4           1021     LEAVE:        CLR    0D4H
1FA0 C2D3           1022                   CLR    0D3H
1FA2 790B           1023                   MOV    R1,#0DBH
1FA4 7B80           1024                   MOV    R3,#HIGH(CARD_OUT)
1FA6 7C48           1025                   MOV    R4,#LOW(CARD_OUT)
1FA8 D2D4           1026                   SETB   0D4H
1FAA D2D3           1027                   SETB   0D3H
1FAC 79BC           1028                   MOV    R1,#0BCH
1FAE 7AB0           1029                   MOV    R2,#0B0H
1FB0 7B03           1030                   MOV    R3,#03H
1FB2 7C60           1031                   MOV    R4,#60H
1FB4 7D08           1032                   MOV    R5,#08H
1FB6 C2D4           1033                   CLR    0D4H
1FB8 C2D3           1034                   CLR    0D3H
1FBA 120000     F   1035                   LCALL  S_CARD_DRIVER_1
1FBD 5003           1036                   JNC    CALC
1FBF 0223AF         1037                   LJMP   EXIT
                    1038
1FC2 0220BB         1039     CALC:         LJMP   C15
                    1040
                    1041     ;--------------------------- ACTIVATE DISPENSER ---------------------------
                    1042
1FC5 7441           1043     STOP_TIME:    MOV    A,#41H                  ;"A- STOP TIME DISPLAY"
1FC7 122372         1044                   LCALL  TX
                    1045
1FCA 121A58         1046     B72:          LCALL  RX                      ;O - PUMP SWITCHED ON
1FCD 644F           1047                   XRL    A,#4FH
1FCF 70F9           1048                   JNZ    B72
                    1049
1FD1 9017D6         1050                   MOV    DPTR,#LABEL5            ;"FUEL DISP ACTIVATED"
1FD4 122401         1051                   LCALL  DISPLAY
1FD7 122413         1052                   LCALL  PAUSE
                    1053
1FDA 9017F9         1054                   MOV    DPTR,#LABEL6            ;"DISPENSING"
1FDD 122401         1055                   LCALL  DISPLAY
                    1056
1FE0 121A58         1057     B71:          LCALL  RX
```

```
LOC  OBJ            LINE     SOURCE

1FE3 644C           1058                      XRL    A,#4CH                 ;COMPARE L-LITRES
1FE5 70F9           1059                      JNZ    B71
                    1060
1FE7 122413         1061                      LCALL  PAUSE
1FEA 9017B3         1062                      MOV    DPTR,#LABEL3           ;"CALC FUEL CONSUMPTION"
1FED 122401         1063                      LCALL  DISPLAY
                    1064
                    1065     ;---------------------------- READING INFO FROM CARD -----------------------
                    1066
1FF0 C2D4           1067                      CLR    0D4H
1FF2 C2D3           1068                      CLR    0D3H
1FF4 790B           1069                      MOV    R1,#0DBH
1FF6 7B80           1070                      MOV    R3,#HIGH(CARD_OUT)
1FF8 7C48           1071                      MOV    R4,#LOW(CARD_OUT)
1FFA D2D4           1072                      SETB   0D4H
1FFC D2D3           1073                      SETB   0D3H
1FFE 79BC           1074                      MOV    R1,#0BCH               ;
2000 7AB0           1075                      MOV    R2,#0B0H               ;READ
2002 7B03           1076                      MOV    R3,#03H                ;TANK/REG NO
2004 7C00           1077                      MOV    R4,#00H                ;
2006 7D10           1078                      MOV    R5,#10H                ;FROM CARD
2008 C2D4           1079                      CLR    0D4H                   ;
200A C2D3           1080                      CLR    0D3H
200C 120000    F    1081                      LCALL  S_CARD_DRIVER_1
200F 5003           1082                      JNC    C5
2011 0223AF         1083                      LJMP   EXIT
                    1084
2014 755910         1085     C5:              MOV    59H,#10H
2017 12209B         1086                      LCALL  XRAM
                    1087
201A C2D4           1088                      CLR    0D4H
201C C2D3           1089                      CLR    0D3H
201E 790B           1090                      MOV    R1,#0DBH
2020 7B80           1091                      MOV    R3,#HIGH(CARD_OUT)
2022 7C48           1092                      MOV    R4,#LOW(CARD_OUT)
2024 D2D4           1093                      SETB   0D4H
2026 D2D3           1094                      SETB   0D3H
2028 79BC           1095                      MOV    R1,#0BCH
202A 7AB0           1096                      MOV    R2,#0B0H
202C 7B03           1097                      MOV    R3,#03H
202E 7C20           1098                      MOV    R4,#20H
2030 7D10           1099                      MOV    R5,#10H
2032 C2D4           1100                      CLR    0D4H
2034 C2D3           1101                      CLR    0D3H
2036 120000    F    1102                      LCALL  S_CARD_DRIVER_1
2039 5003           1103                      JNC    C10
203B 0223AF         1104                      LJMP   EXIT
                    1105
203E 755910         1106     C10:             MOV    59H,#10H
2041 12209B         1107                      LCALL  XRAM
                    1108
2044 C2D4           1109                      CLR    0D4H
2046 C2D3           1110                      CLR    0D3H
2048 790B           1111                      MOV    R1,#0DBH
204A 7B80           1112                      MOV    R3,#HIGH(CARD_OUT)
```

```
LOC  OBJ            LINE     SOURCE

204C 7C48           1113                MOV    R4,#LOW(CARD_OUT)
204E D2D4           1114                SETB   0D4H
2050 D2D3           1115                SETB   0D3H
2052 79BC           1116                MOV    R1,#0BCH
2054 7AB0           1117                MOV    R2,#0B0H
2056 7B03           1118                MOV    R3,#03H
2058 7C40           1119                MOV    R4,#40H
205A 7D10           1120                MOV    R5,#10H
205C C2D4           1121                CLR    0D4H
205E C2D3           1122                CLR    0D3H
2060 120000     F   1123                LCALL  S_CARD_DRIVER_1
2063 5003           1124                JNC    C11
2065 0223AF         1125                LJMP   EXIT
                    1126
2068 755910         1127     C11:       MOV    59H,#10H
206B 12209B         1128                LCALL  XRAM
                    1129
206E C2D4           1130                CLR    0D4H
2070 C2D3           1131                CLR    0D3H
2072 79DB           1132                MOV    R1,#0DBH
2074 7B80           1133                MOV    R3,#HIGH(CARD_OUT)
2076 7C48           1134                MOV    R4,#LOW(CARD_OUT)
2078 D2D4           1135                SETB   0D4H
207A D2D3           1136                SETB   0D3H
207C 79BC           1137                MOV    R1,#0BCH
207E 7AB0           1138                MOV    R2,#0B0H
2080 7B03           1139                MOV    R3,#03H
2082 7C60           1140                MOV    R4,#60H
2084 7D08           1141                MOV    R5,#08H
2086 C2D4           1142                CLR    0D4H
2088 C2D3           1143                CLR    0D3H
208A 120000     F   1144                LCALL  S_CARD_DRIVER_1
208D 5003           1145                JNC    C12
208F 0223AF         1146                LJMP   EXIT
                    1147
2092 755908         1148     C12:       MOV    59H,#08H
2095 12209B         1149                LCALL  XRAM
2098 0220BB         1150                LJMP   C15
                    1151
209B 908048         1152     XRAM:      MOV    DPTR,#CARD_OUT
209E E0             1153     C8:        MOVX   A,@DPTR
209F 122372         1154                LCALL  TX
                    1155
20A2 D2D3           1156                SETB   0D3H                ;
20A4 7850           1157                MOV    R0,#50H             ;
20A6 74FF           1158     E20:       MOV    A,#0FFH             ;
20A8 14             1159     E10:       DEC    A                   ;DELAY ROUTINE
20A9 70FD           1160                JNZ    E10                 ;
20AB D8F9           1161                DJNZ   R0,E20              ;
20AD C2D3           1162                CLR    0D3H                ;
                    1163
20AF A3             1164                INC    DPTR
20B0 E559           1165                MOV    A,59H
20B2 14             1166                DEC    A
20B3 6005           1167                JZ     C9
```

```
LOC  OBJ            LINE     SOURCE

20B5 F559           1168                MOV    59H,A
20B7 02209E         1169                LJMP   C8
20BA 22             1170     C9:        RET
                    1171
                    1172     ;------------------------ SUBTRACT ODO READINGS ---------------------------
                    1173
20BB 756006         1174     C15:       MOV    60H,#06
20BE 908048         1175                MOV    DPTR,#CARD_OUT
20C1 A3             1176                INC    DPTR
20C2 A3             1177                INC    DPTR
20C3 A3             1178                INC    DPTR
20C4 A3             1179                INC    DPTR
20C5 A3             1180                INC    DPTR
20C6 858338         1181                MOV    38H,DPH
20C9 858239         1182                MOV    39H,DPL
                    1183
20CC 1220D5         1184     C30:       LCALL  C40                     ;ADJUST CARD_IN PTR
20CF 1220E4         1185                LCALL  C50                     ;   "  TRAVELLED PTR
20D2 0220F3         1186                LJMP   C60
                    1187
20D5 908034         1188     C40:       MOV    DPTR,#CARD_IN
20D8 A3             1189                INC    DPTR
20D9 A3             1190                INC    DPTR
20DA A3             1191                INC    DPTR
20DB A3             1192                INC    DPTR
20DC A3             1193                INC    DPTR
20DD 858340         1194                MOV    40H,DPH
20E0 858241         1195                MOV    41H,DPL
20E3 22             1196                RET
                    1197
20E4 90C084         1198     C50:       MOV    DPTR,#TRAVELLED
20E7 A3             1199                INC    DPTR
20E8 A3             1200                INC    DPTR
20E9 A3             1201                INC    DPTR
20EA A3             1202                INC    DPTR
20EB A3             1203                INC    DPTR
20EC 858342         1204                MOV    42H,DPH
20EF 858243         1205                MOV    43H,DPL
20F2 22             1206                RET
                    1207
20F3 853883         1208     C60:       MOV    DPH,38H
20F6 853982         1209                MOV    DPL,39H
20F9 C3             1210                CLR    C
20FA E0             1211     C65:       MOVX   A,@DPTR
20FB 540F           1212                ANL    A,#0FH
20FD FA             1213                MOV    R2,A
20FE E582           1214                MOV    A,DPL
2100 14             1215                DEC    A
2101 F582           1216                MOV    DPL,A
2103 858338         1217                MOV    38H,DPH                 ;CARD_OUT  DPTR
2106 858239         1218                MOV    39H,DPL                 ;STORED
                    1219
2109 854083         1220                MOV    DPH,40H
210C 854182         1221                MOV    DPL,41H
210F E0             1222                MOVX   A,@DPTR
```

```
LOC  OBJ           LINE     SOURCE

2110 540F          1223                   ANL    A,#0FH
2112 C0E0          1224                   PUSH   ACC
2114 E582          1225                   MOV    A,DPL
2116 14            1226                   DEC    A
2117 F582          1227                   MOV    DPL,A
2119 858340        1228                   MOV    40H,DPH
211C 858241        1229                   MOV    41H,DPL
211F D0E0          1230                   POP    ACC
2121 9A            1231                   SUBB   A,R2
2122 FD            1232                   MOV    R5,A
2123 E5D0          1233                   MOV    A,PSW
2125 20D704        1234                   JB     PSW.7,ADD_NUM
2128 ED            1235                   MOV    A,R5
2129 02212F        1236                   LJMP   C70
                   1237
212C 022369        1238     ADD_NUM:      LJMP   ADD_10
                   1239
212F 854283        1240     C70:          MOV    DPH,42H
2132 854382        1241                   MOV    DPL,43H
                   1242
2135 F0            1243                   MOVX   @DPTR,A                ;WRITE KM
2136 E582          1244                   MOV    A,DPL                  ;TRAVELLED TO BUFFER
2138 14            1245                   DEC    A                      ;
2139 F582          1246                   MOV    DPL,A
213B 858342        1247                   MOV    42H,DPH
213E 858243        1248                   MOV    43H,DPL
2141 E560          1249                   MOV    A,60H
2143 14            1250                   DEC    A
2144 600B          1251                   JZ     D40
2146 F560          1252                   MOV    60H,A
2148 853883        1253                   MOV    DPH,38H
214B 853982        1254                   MOV    DPL,39H
214E 0220FA        1255                   LJMP   C65
                   1256
2151 E5D0          1257     D40:          MOV    A,PSW
2153 30D714        1258                   JNB    PSW.7,CYCLE_CHK
2156 90189E        1259                   MOV    DPTR,#LABEL15          ;'Incorrect odo meter entry'
2159 122401        1260                   LCALL  DISPLAY
215C 122413        1261                   LCALL  PAUSE
215F 90C082        1262                   MOV    DPTR,#COUNT
2162 7402          1263                   MOV    A,#02H
2164 F0            1264                   MOVX   @DPTR,A
2165 C2D7          1265                   CLR    PSW.7
2167 021EF4        1266                   LJMP   C20
                   1267
216A 90C082        1268     CYCLE_CHK:    MOV    DPTR,#COUNT
216D E0            1269                   MOVX   A,@DPTR
216E 14            1270                   DEC    A
216F 6006          1271                   JZ     WRITE_TRAVEL
2171 F0            1272                   MOVX   @DPTR,A
2172 C2D7          1273                   CLR    PSW.7
2174 021FC5        1274                   LJMP   STOP_TIME
                   1275
2177 90C084        1276     WRITE_TRAVEL: MOV    DPTR,#TRAVELLED
217A A3            1277                   INC    DPTR
```

```
LOC  OBJ            LINE     SOURCE

217B A3             1278                     INC    DPTR
217C A3             1279                     INC    DPTR
217D E0             1280                     MOVX   A,@DPTR               ;"06"
217E 2430           1281                     ADD    A,#30H
2180 A3             1282                     INC    DPTR
2181 122372         1283                     LCALL  TX
                    1284
2184 E0             1285                     MOVX   A,@DPTR               ;"08"
2185 2430           1286                     ADD    A,#30H
2187 A3             1287                     INC    DPTR
2188 122372         1288                     LCALL  TX
                    1289
218B E0             1290                     MOVX   A,@DPTR               ;"09"
218C 2430           1291                     ADD    A,#30H
218E 122372         1292                     LCALL  TX
                    1293
2191 90C08A         1294                     MOV    DPTR,#AVERAGE
2194 121A58         1295                     LCALL  RX
2197 F0             1296                     MOVX   @DPTR,A               ;"31"
2198 A3             1297                     INC    DPTR
                    1298
2199 121A58         1299                     LCALL  RX
219C F0             1300                     MOVX   @DPTR,A               ;"31"
219D A3             1301                     INC    DPTR
                    1302
219E 121A58         1303                     LCALL  RX
21A1 F0             1304                     MOVX   @DPTR,A               ;"."
21A2 A3             1305                     INC    DPTR
                    1306
21A3 121A58         1307                     LCALL  RX
21A6 F0             1308                     MOVX   @DPTR,A
21A7 A3             1309                     INC    DPTR                  ;"34"
                    1310
21A8 121A58         1311                     LCALL  RX
21AB F0             1312                     MOVX   @DPTR,A               ;"38"
                    1313
21AC 901832         1314     CONSUME:        MOV    DPTR,#LABEL9          ;"FUEL CONSUMED"
21AF 122401         1315                     LCALL  DISPLAY
                    1316
21B2 7443           1317                     MOV    A,#43H
21B4 120000    F    1318                     LCALL  S_LCD_CHX_PTR
                    1319
21B7 90C08A         1320                     MOV    DPTR,#AVERAGE
21BA E0             1321                     MOVX   A,@DPTR
21BB A3             1322                     INC    DPTR
21BC 120000    F    1323                     LCALL  S_LCD_CHAR_OUT         ;"31"
                    1324
21BF E0             1325                     MOVX   A,@DPTR
21C0 A3             1326                     INC    DPTR
21C1 120000    F    1327                     LCALL  S_LCD_CHAR_OUT         ;"31"
                    1328
21C4 E0             1329                     MOVX   A,@DPTR
21C5 A3             1330                     INC    DPTR
21C6 120000    F    1331                     LCALL  S_LCD_CHAR_OUT           ;"."
                    1332
```

```
LOC  OBJ            LINE     SOURCE

21C9 E0             1333                  MOVX   A,@DPTR
21CA A3             1334                  INC    DPTR
21CB 120000    F    1335                  LCALL  S_LCD_CHAR_OUT           ;"34"
                    1336
21CE E0             1337                  MOVX   A,@DPTR
21CF A3             1338                  INC    DPTR
21D0 120000    F    1339                  LCALL  S_LCD_CHAR_OUT           ;"38"
                    1340
21D3 7420           1341                  MOV    A,#20H
21D5 120000    F    1342                  LCALL  S_LCD_CHAR_OUT
                    1343
21D8 746B           1344                  MOV    A,#6BH                   ;"k"
21DA 120000    F    1345                  LCALL  S_LCD_CHAR_OUT
                    1346
21DD 746D           1347                  MOV    A,#6DH                   ;"m"
21DF 120000    F    1348                  LCALL  S_LCD_CHAR_OUT
                    1349
21E2 742F           1350                  MOV    A,#2FH                   ;"/"
21E4 120000    F    1351                  LCALL  S_LCD_CHAR_OUT
                    1352
21E7 746C           1353                  MOV    A,#6CH                   ;"l"
21E9 120000    F    1354                  LCALL  S_LCD_CHAR_OUT
21EC 122413         1355                  LCALL  PAUSE
21EF 122413         1356                  LCALL  PAUSE
                    1357
                    1358     ;--------------------------- UPDATE ODO ON CARD --------------------------
                    1359
21F2 90187B         1360                  MOV    DPTR,#LABEL14            ;"Updating card info"
21F5 122401         1361                  LCALL  DISPLAY
                    1362
21F8 908034         1363                  MOV    DPTR,#CARD_IN
21FB 7411           1364                  MOV    A,#11H
21FD 753A08         1365                  MOV    3AH,#08H
2200 F0             1366     NEXT:        MOVX   @DPTR,A
2201 A3             1367                  INC    DPTR
2202 C0E0           1368                  PUSH   ACC
2204 E53A           1369                  MOV    A,3AH
2206 14             1370                  DEC    A
2207 6007           1371                  JZ     ERASE
2209 F53A           1372                  MOV    3AH,A
220B D0E0           1373                  POP    ACC
220D 022200         1374                  LJMP   NEXT
                    1375
2210 C2D4           1376     ERASE:       CLR    0D4H
2212 C2D3           1377                  CLR    0D3H
2214 79DA           1378                  MOV    R1,#0DAH
2216 7B80           1379                  MOV    R3,#HIGH(CARD_IN)
2218 7C34           1380                  MOV    R4,#LOW(CARD_IN)
221A D2D4           1381                  SETB   0D4H
221C D2D3           1382                  SETB   0D3H
221E 79BC           1383                  MOV    R1,#0BCH
2220 7A10           1384                  MOV    R2,#10H
2222 7B00           1385                  MOV    R3,#00H
2224 7C00           1386                  MOV    R4,#00H
2226 7D08           1387                  MOV    R5,#08H
```

```
LOC  OBJ            LINE     SOURCE

2228 C2D4           1388                  CLR    0D4H
222A C2D3           1389                  CLR    0D3H
222C 120000   F     1390                  LCALL  S_CARD_DRIVER_1
222F 5003           1391                  JNC    PROCEED
2231 0223AF         1392                  LJMP   EXIT
                    1393
2234 C2D4           1394     PROCEED:     CLR    0D4H
2236 C2D3           1395                  CLR    0D3H
2238 790A           1396                  MOV    R1,#0DAH
223A 7B80           1397                  MOV    R3,#HIGH(CARD_IN)
223C 7C34           1398                  MOV    R4,#LOW(CARD_IN)
223E D2D4           1399                  SETB   0D4H
2240 D2D3           1400                  SETB   0D3H
2242 79BC           1401                  MOV    R1,#0BCH
2244 7A40           1402                  MOV    R2,#40H
2246 7BFF           1403                  MOV    R3,#0FFH
2248 7CFF           1404                  MOV    R4,#0FFH
224A 7D00           1405                  MOV    R5,#00H
224C C2D4           1406                  CLR    0D4H
224E C2D3           1407                  CLR    0D3H
2250 120000   F     1408                  LCALL  S_CARD_DRIVER_1
2253 5003           1409                  JNC    ERASING
2255 0223AF         1410                  LJMP   EXIT
                    1411
2258 908034         1412     ERASING:     MOV    DPTR,#CARD_IN
225B 7403           1413                  MOV    A,#03H
225D F0             1414                  MOVX   @DPTR,A
225E A3             1415                  INC    DPTR
225F 7470           1416                  MOV    A,#70H
2261 F0             1417                  MOVX   @DPTR,A
                    1418
2262 C2D4           1419                  CLR    0D4H
2264 C2D3           1420                  CLR    0D3H
2266 790A           1421                  MOV    R1,#0DAH
2268 7B80           1422                  MOV    R3,#HIGH(CARD_IN)
226A 7C34           1423                  MOV    R4,#LOW(CARD_IN)
226C D2D4           1424                  SETB   0D4H
226E D2D3           1425                  SETB   0D3H
2270 79BC           1426                  MOV    R1,#0BCH
2272 7A0E           1427                  MOV    R2,#0EH
2274 7B03           1428                  MOV    R3,#03H
2276 7C60           1429                  MOV    R4,#60H
2278 7D02           1430                  MOV    R5,#02H
227A C2D4           1431                  CLR    0D4H
227C C2D3           1432                  CLR    0D3H
227E 120000   F     1433                  LCALL  S_CARD_DRIVER_1
2281 5003           1434                  JNC    UPDATE_KM
2283 0223AF         1435                  LJMP   EXIT
                    1436
2286 C2D4           1437     UPDATE_KM:   CLR    0D4H
2288 C2D3           1438                  CLR    0D3H
228A 790A           1439                  MOV    R1,#0DAH
228C 7B80           1440                  MOV    R3,#HIGH(TEMP_PIN)
228E 7C68           1441                  MOV    R4,#LOW(TEMP_PIN)
2290 D2D4           1442                  SETB   0D4H
```

```
LOC  OBJ            LINE     SOURCE

2292 D2D3           1443                        SETB   0D3H
2294 79BC           1444                        MOV    R1,#0BCH
2296 7A20           1445                        MOV    R2,#20H
2298 7B00           1446                        MOV    R3,#00H
229A 7C00           1447                        MOV    R4,#00H
229C 7D08           1448                        MOV    R5,#08H
229E C2D4           1449                        CLR    0D4H
22A0 C2D3           1450                        CLR    0D3H
22A2 120000    F    1451                        LCALL  S_CARD_DRIVER_1
22A5 5003           1452                        JNC    INIT_CARD
22A7 021E19         1453                        LJMP   A50
                    1454
22AA C2D4           1455     INIT_CARD:         CLR    0D4H
22AC C2D3           1456                        CLR    0D3H
22AE 79DA           1457                        MOV    R1,#0DAH
22B0 7B80           1458                        MOV    R3,#HIGH(TEMP_PIN)
22B2 7C68           1459                        MOV    R4,#LOW(TEMP_PIN)
22B4 D2D4           1460                        SETB   0D4H
22B6 D2D3           1461                        SETB   0D3H
22B8 79BC           1462                        MOV    R1,#0BCH
22BA 7A40           1463                        MOV    R2,#40H
22BC 7BFF           1464                        MOV    R3,#0FFH
22BE 7CFF           1465                        MOV    R4,#0FFH
22C0 7D00           1466                        MOV    R5,#00H
22C2 C2D4           1467                        CLR    0D4H
22C4 C2D3           1468                        CLR    0D3H
22C6 120000    F    1469                        LCALL  S_CARD_DRIVER_1
22C9 5003           1470                        JNC    RAZ_CARD
22CB 021E19         1471                        LJMP   A50
                    1472
22CE 90C08F         1473     RAZ_CARD:          MOV    DPTR,#ODO
22D1 C2D4           1474                        CLR    0D4H
22D3 C2D3           1475                        CLR    0D3H
22D5 79DA           1476                        MOV    R1,#0DAH
22D7 7BC0           1477                        MOV    R3,#HIGH(ODO)
22D9 7C8F           1478                        MOV    R4,#LOW(ODO)
22DB D2D4           1479                        SETB   0D4H
22DD D2D3           1480                        SETB   0D3H
22DF 79BC           1481                        MOV    R1,#0BCH
22E1 7AD0           1482                        MOV    R2,#0D0H
22E3 7B03           1483                        MOV    R3,#03H
22E5 7C60           1484                        MOV    R4,#60H
22E7 7D04           1485                        MOV    R5,#04H
22E9 C2D4           1486                        CLR    0D4H
22EB C2D3           1487                        CLR    0D3H
22ED 120000    F    1488                        LCALL  S_CARD_DRIVER_1
22F0 5003           1489                        JNC    WRITE_VAL
22F2 0223AF         1490                        LJMP   EXIT
                    1491
22F5 90C08F         1492     WRITE_VAL:         MOV    DPTR,#ODO
22F8 C2D4           1493                        CLR    0D4H
22FA C2D3           1494                        CLR    0D3H
22FC 79DA           1495                        MOV    R1,#0DAH
22FE 7BC0           1496                        MOV    R3,#HIGH(ODO)
2300 7C8F           1497                        MOV    R4,#LOW(ODO)
```

```
LOC  OBJ            LINE     SOURCE

2302 D2D4           1498                        SETB   0D4H
2304 D2D3           1499                        SETB   0D3H
2306 79BC           1500                        MOV    R1,#0BCH
2308 7A70           1501                        MOV    R2,#70H
230A 7B03           1502                        MOV    R3,#03H
230C 7C60           1503                        MOV    R4,#60H
230E 7D00           1504                        MOV    R5,#00H
2310 C2D4           1505                        CLR    0D4H
2312 C2D3           1506                        CLR    0D3H
2314 120000     F   1507                        LCALL  S_CARD_DRIVER_1
2317 5003           1508                        JNC    NEXT_NIBBLE
2319 0223AF         1509                        LJMP   EXIT
                    1510
231C 90C097         1511     NEXT_NIBBLE:       MOV    DPTR,#ODO_LOW_BYTE
231F C2D4           1512                                   CLR     0D4H
2321 C2D3           1513                        CLR    0D3H
2323 790A           1514                        MOV    R1,#0DAH
2325 7BC0           1515                        MOV    R3,#HIGH(ODO_LOW_BYTE)
2327 7C97           1516                        MOV    R4,#LOW(ODO_LOW_BYTE)
2329 D2D4           1517                        SETB   0D4H
232B D2D3           1518                        SETB   0D3H
232D 79BC           1519                        MOV    R1,#0BCH
232F 7AD0           1520                        MOV    R2,#0D0H
2331 7B03           1521                        MOV    R3,#03H
2333 7C68           1522                        MOV    R4,#68H
2335 7D04           1523                        MOV    R5,#04H
2337 C2D4           1524                        CLR    0D4H
2339 C2D3           1525                        CLR    0D3H
233B 120000     F   1526                        LCALL  S_CARD_DRIVER_1
233E 5003           1527                        JNC    WRITE_VAL_1
2340 0223AF         1528                        LJMP   EXIT
                    1529
2343 122413         1530     WRITE_VAL_1:       LCALL  PAUSE
2346 90C097         1531                        MOV    DPTR,#ODO_LOW_BYTE
2349 790A           1532                        MOV    R1,#0DAH
234B 7BC0           1533                        MOV    R3,#HIGH(ODO_LOW_BYTE)
234D 7C97           1534                        MOV    R4,#LOW(ODO_LOW_BYTE)
234F D2D4           1535                        SETB   0D4H
2351 D2D3           1536                        SETB   0D3H
2353 79BC           1537                        MOV    R1,#0BCH
2355 7A70           1538                        MOV    R2,#70H
2357 7B03           1539                        MOV    R3,#03H
2359 7C68           1540                        MOV    R4,#68H
235B 7D00           1541                        MOV    R5,#00H
235D C2D4           1542                        CLR    0D4H
235F C2D3           1543                        CLR    0D3H
2361 120000     F   1544                        LCALL  S_CARD_DRIVER_1
2364 5000           1545                        JNC    TAKE_CARD
                    1546
2366 02236F         1547     TAKE_CARD:         LJMP   C120
                    1548
2369 ED             1549     ADD_10:            MOV    A,R5
236A 240A           1550                        ADD    A,#0AH
236C 02212F         1551                        LJMP   C70
                    1552
```

```
LOC  OBJ            LINE     SOURCE

236F 0223AF         1553     C120:          LJMP   EXIT
                    1554
                    1555     ;------------------------------ TRANSMIT ROUTINE -------------------------
                    1556
2372 C299           1557     TX:            CLR    TI
2374 F599           1558                    MOV    SBUF,A
2376 3099FD         1559                    JNB    TI,$
2379 22             1560                    RET
                    1561
                    1562     ;------------------------------ DUMMY RX ROUTINE -------------------------
                    1563
237A 121A58         1564     NO_RX:         LCALL  RX
237D 90C083         1565                    MOV    DPTR,#DUMMY_RX
2380 F0             1566                    MOVX   @DPTR,A
2381 22             1567                    RET
                    1568
                    1569     ;-------------------------- ILLEGAL SYSTEM PASSWORD ----------------------
                    1570
2382 7402           1571     STOP:          MOV    A,#02H
2384 020000    F    1572                    LJMP   FIN
                    1573
                    1574     ;---------------------------- POWER DOWN CARD ----------------------------
                    1575
2387 C2D3           1576     EXIT1:         CLR    0D3H
2389 C2D4           1577                    CLR    0D4H
238B 794D           1578                    MOV    R1,#4DH
238D 120000    F    1579                    LCALL  S_CARD_DRIVER_1
2390 5003           1580                    JNC    CONTI
2392 022387         1581                    LJMP   EXIT1
                    1582
2395 D2D3           1583     CONTI:         SETB   0D3H
2397 D2D4           1584                    SETB   0D4H
2399 E8             1585                    MOV    A,R0
239A 122372         1586                    LCALL  TX
239D EE             1587                    MOV    A,R6
239E 122372         1588                    LCALL  TX
23A1 EF             1589                    MOV    A,R7
23A2 122372         1590                    LCALL  TX
23A5 C2D3           1591                    CLR    0D3H
23A7 C2D4           1592                    CLR    0D4H
                    1593
23A9 20B3FD         1594     CARDIN:        JB     P3.3,CARDIN
23AC 0223DD         1595                    LJMP   CARD_PRES1
                    1596
                    1597     ;-------------------------- POWER DOWN CARD 1 -----------------------------
                    1598
23AF C2D3           1599     EXIT:          CLR    0D3H
23B1 C2D4           1600                    CLR    0D4H
23B3 794D           1601                    MOV    R1,#4DH                ;POWER OFF CARD
23B5 120000    F    1602                    LCALL  S_CARD_DRIVER_1
23B8 5003           1603                    JNC    DISP1
23BA 0223AF         1604                    LJMP   EXIT
                    1605
23BD D2D3           1606     DISP1:         SETB   0D3H
23BF D2D4           1607                    SETB   0D4H
```

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LOC  OBJ            LINE     SOURCE

23C1 E8             1608                       MOV    A,R0
23C2 122372         1609                       LCALL  TX
23C5 EE             1610                       MOV    A,R6
23C6 122372         1611                       LCALL  TX
23C9 EF             1612                       MOV    A,R7
23CA 122372         1613                       LCALL  TX
23CD C2D3           1614                       CLR    0D3H
23CF C2D4           1615                       CLR    0D4H
                    1616
23D1 90180C         1617                       MOV    DPTR,#LABEL7            ;"PLSE TAKE CARD"
23D4 122401         1618                       LCALL  DISPLAY
23D7 0223DA         1619                       LJMP   CARD_PRES
                    1620
23DA 20B3FD         1621     CARD_PRES:        JB     P3.3,CARD_PRES
23DD 90181F         1622     CARD_PRES1:       MOV    DPTR,#LABEL8             ;"HAVE A NICE DAY!"
23E0 122401         1623                       LCALL  DISPLAY
23E3 122413         1624                       LCALL  PAUSE
                    1625
23E6 121A58         1626     READ_RX:          LCALL  RX
23E9 B44409         1627                       CJNE   A,#44H,GOTO_BEGIN
23EC 9018C1         1628                       MOV    DPTR,#DWNLD              ;"DOWNLOADING IN PROGRESS"
23EF 122401         1629                       LCALL  DISPLAY
23F2 0223E6         1630                       LJMP   READ_RX
                    1631
23F5 90C082         1632     GOTO_BEGIN:       MOV    DPTR,#COUNT
23F8 7403           1633                       MOV    A,#03H
23FA F0             1634                       MOVX   @DPTR,A
23FB 758107         1635                       MOV    SP,#07H
23FE 021BC5         1636                       LJMP   INS
                    1637
                    1638     ;------------------------------ DISPLAY ROUTINE ----------------------------
                    1639
2401 120000    F    1640     DISPLAY:          LCALL  S_BLANK_LCD
2404 C3             1641                       CLR    C
2405 120000    F    1642                       LCALL  S_LCD_MSGC_OUT
2408 22             1643                       RET
                    1644
                    1645     ;------------------------------ KEY READ ROUTINE ---------------------------
                    1646
2409 120000    F    1647     KEYS:             LCALL  S_KEY_IN
240C F4             1648                       CPL    A
240D 7002           1649                       JNZ    KEY_PRESSED
240F 80F8           1650                       JMP    KEYS
                    1651
2411 F4             1652     KEY_PRESSED:      CPL    A
2412 22             1653                       RET
                    1654
                    1655     ;---------------------------- PAUSE (DELAY) ROUTINE -----------------------
                    1656
2413 7403           1657     PAUSE:            MOV    A,#03H
2415 120000    F    1658                       LCALL  TEMPO                   ;1.5 SEC DELAY
2418 22             1659                       RET
                    1660
                    1661
                             ;---------------------------------------------------------------------------

                    1662     END
```

```
SYMBOL TABLE LISTING
------ ----- -------


N A M E          T Y P E  V A L U E       A T T R I B U T E S

A100. . . . . .  C ADDR   1A60H   A
A110. . . . . .  C ADDR   1A69H   A
A115. . . . . .  C ADDR   1A71H   A
A120. . . . . .  C ADDR   1AC8H   A
A135. . . . . .  C ADDR   1AF8H   A
A140. . . . . .  C ADDR   1AE6H   A
A150. . . . . .  C ADDR   1B73H   A
A160. . . . . .  C ADDR   1B05H   A
A210. . . . . .  C ADDR   1A10H   A
A220. . . . . .  C ADDR   1A16H   A
A300. . . . . .  C ADDR   1B40H   A
A320. . . . . .  C ADDR   1B32H   A
A321. . . . . .  C ADDR   1B5BH   A
A40 . . . . . .  C ADDR   1BD7H   A
A50 . . . . . .  C ADDR   1E19H   A
A51 . . . . . .  C ADDR   1ECAH   A
A60 . . . . . .  C ADDR   19F7H   A
A70 . . . . . .  C ADDR   1A52H   A
A90 . . . . . .  C ADDR   1A45H   A
ACC . . . . . .  D ADDR   00E0H   A
ACCESS. . . . .  C ADDR   1523H   A
ADD_10. . . . .  C ADDR   2369H   A
ADD_NUM . . . .  C ADDR   212CH   A
APPLI . . . . .  C ADDR   18E7H   A PUB
APPLI1. . . . .  C ADDR   18E7H   A
APX . . . . . .  C ADDR   18EBH   A
AST . . . . . .  C ADDR   1647H   A
AVERAGE . . . .  X ADDR   C08AH   A
B100. . . . . .  C ADDR   1E2DH   A
B20 . . . . . .  C ADDR   1D74H   A
B40 . . . . . .  C ADDR   1D7EH   A
B50 . . . . . .  C ADDR   1DA6H   A
B60 . . . . . .  C ADDR   1F12H   A
B65 . . . . . .  C ADDR   1F2DH   A
B70 . . . . . .  C ADDR   1F6AH   A
B71 . . . . . .  C ADDR   1FE0H   A
B72 . . . . . .  C ADDR   1FCAH   A
B75 . . . . . .  C ADDR   1F32H   A
B80 . . . . . .  C ADDR   1F06H   A
BACK. . . . . .  C ADDR   191FH   A
BADTEL. . . . .  C ADDR   1D42H   A
BAT_FAILURE_MSG  X ADDR   8000H   A PUB
BAT_LOOP. . . .  C ADDR   1C71H   A
BATTERY . . . .  C ADDR   1546H   A
BFCP8 . . . . .  X ADDR   8023H   A PUB
C10 . . . . . .  C ADDR   203EH   A
C11 . . . . . .  C ADDR   2068H   A
C12 . . . . . .  C ADDR   2092H   A
C120. . . . . .  C ADDR   236FH   A
C15 . . . . . .  C ADDR   208BH   A
C20 . . . . . .  C ADDR   1EF4H   A
```

```
N A M E         T Y P E   V A L U E      A T T R I B U T E S

C30 . . . . . . C ADDR    20CCH   A
C40 . . . . . . C ADDR    20D5H   A
C5. . . . . . . C ADDR    2014H   A
C50 . . . . . . C ADDR    20E4H   A
C60 . . . . . . C ADDR    20F3H   A
C65 . . . . . . C ADDR    20FAH   A
C70 . . . . . . C ADDR    212FH   A
C8. . . . . . . C ADDR    209EH   A
C9. . . . . . . C ADDR    208AH   A
CALC. . . . . . C ADDR    1FC2H   A
CARD_IN . . . . X ADDR    8034H   A
CARD_OUT. . . . X ADDR    8048H   A
CARD_PRES . . . C ADDR    23DAH   A
CARD_PRES1. . . C ADDR    23DDH   A
CARDFAULT . . . C ADDR    1BF6H   A
CARDIN. . . . . C ADDR    23A9H   A
CHANGE. . . . . C ADDR    1744H   A
CHG . . . . . . C ADDR    1AFBH   A
CHK_TELE. . . . C ADDR    1C8BH   A
CMPR. . . . . . C ADDR    1C17H   A
COMPARE . . . . C ADDR    1943H   A
CONSUME . . . . C ADDR    21ACH   A
CONSUMPTION . . X ADDR    C09BH   A
CONTI . . . . . C ADDR    2395H   A
CORR. . . . . . C ADDR    1B6DH   A
COUNT . . . . . X ADDR    C082H   A
CURR. . . . . . C ADDR    16D8H   A
CYCLE_CHK . . . C ADDR    216AH   A
D10 . . . . . . C ADDR    1930H   A
D40 . . . . . . C ADDR    2151H   A
DAG . . . . . . C ADDR    170EH   A
DATE_DISPLAY. . C ADDR    19E4H   A
DATE. . . . . . X ADDR    805CH   A
DAY . . . . . . C ADDR    1A07H   A
DISP1 . . . . . C ADDR    23BDH   A
DISPLAY_TIME. . C ADDR    1A80H   A
DISPLAY . . . . C ADDR    2401H   A
DPH . . . . . . D ADDR    0083H   A
DPL . . . . . . D ADDR    0082H   A
DRIVE . . . . . C ADDR    165CH   A
DUMMY_RX. . . . X ADDR    C083H   A
DWNLD . . . . . C ADDR    18C1H   A
E10 . . . . . . C ADDR    20A8H   A
E20 . . . . . . C ADDR    20A6H   A
EA. . . . . . . B ADDR    00A8H.7 A
ENTER_DATE. . . C ADDR    16EBH   A
ENTER_PIN . . . C ADDR    1D54H   A
ERASE . . . . . C ADDR    2210H   A
ERASING . . . . C ADDR    2258H   A
ERROR . . . . . C ADDR    15C2H   A
ESCAPE. . . . . C ADDR    1BC2H   A
EX1 . . . . . . B ADDR    00A8H.2 A
EXIT. . . . . . C ADDR    23AFH   A
EXIT1 . . . . . C ADDR    2387H   A
FAULTY. . . . . C ADDR    15E8H   A
```

```
N A M E          T Y P E   V A L U E       A T T R I B U T E S

FIN . . . . . .  C ADDR    ----      EXT
FUEL_DISPENSER.    ----    ----
FUEL. . . . . .  C ADDR    1500H   A
GDTELP2 . . . .  C ADDR    1CC3H   A
GDTELP3 . . . .  C ADDR    1CE3H   A
GO_ON . . . . .  C ADDR    1DB1H   A
GOOD_DAY. . . .  C ADDR    1634H   A
GOOD. . . . . .  C ADDR    1C08H   A
GOOD2 . . . . .  C ADDR    1C3AH   A
GOTO_BEGIN. . .  C ADDR    23F5H   A
HALT. . . . . .  C ADDR    ----      EXT
HERHAAL . . . .  C ADDR    1DBAH   A
ILLEGAL . . . .  C ADDR    160EH   A
IN_AREA . . . .  I SEG     0040H               REL=UNIT
INIT_CARD . . .  C ADDR    22AAH   A
INPUT . . . . .  C ADDR    1910H   A
INS . . . . . .  C ADDR    1BC5H   A
INSERT. . . . .  C ADDR    1569H   A
IT1 . . . . . .  B ADDR    0088H.2 A
ITIMER0 . . . .  C ADDR    18E6H   A PUB
KEY_PRESSED . .  C ADDR    2411H   A
KEYS. . . . . .  C ADDR    2409H   A
KILO. . . . . .  C ADDR    176AH   A
LABEL1. . . . .  C ADDR    1780H   A
LABEL12 . . . .  C ADDR    1845H   A
LABEL13 . . . .  C ADDR    1868H   A
LABEL14 . . . .  C ADDR    187BH   A
LABEL15 . . . .  C ADDR    189EH   A
LABEL2. . . . .  C ADDR    17A0H   A
LABEL3. . . . .  C ADDR    17B3H   A
LABEL5. . . . .  C ADDR    17D6H   A
LABEL6. . . . .  C ADDR    17F9H   A
LABEL7. . . . .  C ADDR    180CH   A
LABEL8. . . . .  C ADDR    181FH   A
LABEL9. . . . .  C ADDR    1832H   A
LCD_PTR . . . .  X ADDR    8033H   A PUB
LEAVE . . . . .  C ADDR    1F9EH   A
LOAD_PIN. . . .  C ADDR    1DC8H   A
LOCK. . . . . .  C ADDR    1C28H   A
LOCKED. . . . .  C ADDR    15D5H   A
LOW_BYTE. . . .  C ADDR    1F7CH   A
MESSAGE . . . .  C ADDR    1B84H   A
MSG . . . . . .  C ADDR    1B95H   A
NEW_DATE. . . .  C ADDR    1A1BH   A
NEW_TIME. . . .  C ADDR    1AD7H   A
NEXT_DIGIT. . .  C ADDR    19D0H   A
NEXT_NIBBLE . .  C ADDR    231CH   A
NEXT. . . . . .  C ADDR    2200H   A
NO_RX . . . . .  C ADDR    237AH   A
NO. . . . . . .  C ADDR    1685H   A
NOT_EQ. . . . .  C ADDR    1F59H   A
NOT_EQ1 . . . .  C ADDR    1F5FH   A
ODO_LOW_BYTE. .  X ADDR    C097H   A
ODO . . . . . .  X ADDR    C08FH   A
OUT . . . . . .  C ADDR    1D65H   A
```

```
N A M E         T Y P E   V A L U E      A T T R I B U T E S

P3. . . . . . . D ADDR    00B0H   A
PASS. . . . . . C ADDR    16A2H   A
PAUSE . . . . . C ADDR    2413H   A
PCON. . . . . . D ADDR    0087H   A
PIN_CORRECT . . C ADDR    1ED5H   A
PIN . . . . . . C ADDR    15AFH   A
PORT. . . . . . C ADDR    1649H   A
PROC_SETUP. . . C ADDR    1978H   A
PROCEED . . . . C ADDR    2234H   A
PSW . . . . . . D ADDR    00D0H   A
RAZ_CARD. . . . C ADDR    22CEH   A
READ_RX . . . . C ADDR    23E6H   A
REMOVE_CARD . . C ADDR    1C31H   A
REMOVE. . . . . C ADDR    158CH   A
RI. . . . . . . B ADDR    0098H.0 A
RX. . . . . . . C ADDR    1A58H   A
S_BLANK_LCD . . C ADDR    ----      EXT
S_CARD_DRIVER_1 C ADDR    ----      EXT
S_CARD_REMOVED. C ADDR    1C8AH   A PUB
S_COPY_MSG_BAT. C ADDR    1C61H   A PUB
S_KEY_IN. . . . C ADDR    ----      EXT
S_KEY_RELEASE . C ADDR    ----      EXT
S_LCD_CHAR_OUT. C ADDR    ----      EXT
S_LCD_CHX_PTR . C ADDR    ----      EXT
S_LCD_MSGC_OUT. C ADDR    ----      EXT
S_LCD_MSGX_OUT. C ADDR    ----      EXT
SBUF. . . . . . D ADDR    0099H   A
SCON. . . . . . D ADDR    0098H   A
SECURITY. . . . C ADDR    1621H   A
SEND_TEL. . . . C ADDR    19DBH   A
SETUP . . . . . C ADDR    167FH   A
SP. . . . . . . D ADDR    0081H   A
STACK . . . . . I ADDR    0000H   R PUB    SEG=IN_AREA
STATUS. . . . . C ADDR    1ECDH   A
STOP_TIME . . . C ADDR    1FC5H   A
STOP. . . . . . C ADDR    2382H   A
SYS_PASS. . . . X ADDR    807CH   A
T20 . . . . . . C ADDR    1A8FH   A
T30 . . . . . . C ADDR    1AA5H   A
T40 . . . . . . C ADDR    1AB0H   A
TAKE_CARD . . . C ADDR    2366H   A
TEL . . . . . . X ADDR    C09FH   A
TEMP_PIN. . . . X ADDR    8068H   A
TEMPO . . . . . C ADDR    ----      EXT
TEST. . . . . . C ADDR    1C5EH   A
TH1 . . . . . . D ADDR    008DH   A
TI. . . . . . . B ADDR    0098H.1 A
TIME_CHANGE . . C ADDR    1757H   A
TL1 . . . . . . D ADDR    008BH   A
TMOD. . . . . . D ADDR    0089H   A
TOETS . . . . . C ADDR    1B4FH   A
TR1 . . . . . . B ADDR    0088H.6 A
TRANS . . . . . C ADDR    1B8DH   A
TRANSACT. . . . X ADDR    8082H   A
TRAVELLED . . . X ADDR    C084H   A
```

```
N A M E         T Y P E  V A L U E      A T T R I B U T E S

TST_0 . . . . . C ADDR   19B7H   A
TX. . . . . . . C ADDR   2372H   A
TYD . . . . . . C ADDR   1731H   A
UPDATE_KM . . . C ADDR   2286H   A
VAL_PASS. . . . C ADDR   1E54H   A
VALIDATE_PASS . C ADDR   1E78H   A
VALIDATE_PIN. . C ADDR   1E83H   A
VALIDATE_READ . C ADDR   1EBBH   A
W20 . . . . . . C ADDR   19A8H   A
W30 . . . . . . C ADDR   1990H   A
W40 . . . . . . C ADDR   19C7H   A
WAIT. . . . . . C ADDR   15FBH   A
WRITE_DIGIT . . C ADDR   19BCH   A
WRITE_ODO . . . C ADDR   1F3BH   A
WRITE_TEL . . . C ADDR   19B1H   A
WRITE_TRAVEL. . C ADDR   2177H   A
WRITE_VAL_1 . . C ADDR   2343H   A
WRITE_VAL . . . C ADDR   22F5H   A
WRONG . . . . . C ADDR   196CH   A
X10 . . . . . . C ADDR   1DECH   A
X20 . . . . . . C ADDR   1E30H   A
XRAM. . . . . . C ADDR   209BH   A


REGISTER BANK(S) USED: 0

ASSEMBLY COMPLETE, 0 ERRORS FOUND
```

```
program CONTROL STATION;
uses
  dos,crt,printer;
(***)

{$L COMMS}   {Link the following routines in COMMS.OBJ}

Procedure CommInit ( port : word; params : byte); EXTERNAL;
Function CharReady : Boolean; EXTERNAL;
Function GetByte : Byte; EXTERNAL;
Procedure SendByte ( theByte : Byte) ; EXTERNAL;

Const baud110    = $00; {Baud rate settings}
      baud150    = $20;
      baud300    = $40;
      baud600    = $60;
      baud1200   = $80;
      baud2400   = $A0;
      baud4800   = $C0;
      baud9600   = $E0;

      noparity   = $00;
      oddparity  = $08;
      evenparity = $18;

      onestop    = $00;
      twostop    = $04;

      len7       = $02;
      len8       = $03;

      Xon        = ^Q;  {Flow control characters}
      Xoff       = ^S;

type
  Trail  = record
             Time : string[12];
           end;
  Str100 = string[100];

  Petrol = record
             Tank, Reg, Driv, Supl, Odeo, Dist,
             Litre, Cons, Date, Day, Time, Loc   : string;
           end;
const
   HXas : integer = 20;
   HYas : integer = 25;
   Xas  : integer = 30;
   Yas  : integer = 12;
   Item : array[1..3] of string[16] = (' DISPENSER INFO  ',
                                       ' DOWNLOAD SCREEN ',
                                       ' QUIT            ');
   Help : array[1..3] of string[44]= ('      Display vechile info        ',
                                      '     Default screen    ESC - exit  ',
                                      '           Exit to DOS             ');
   SpeedH  = 05;
   SpeedV  = 10;
   Lyn  : array[1..6] of char = ('+','+','|','+','-','+');
var
   Fil     : file of Petrol;
   Dat     : Petrol;
   Ch      : char;
   Choice  : integer;
   Net     : array[1..32000] of char;
   Data    : array[1..10] of str100;
   Fs      : text;
   I       : integer;
   Datum   : string;
   Save_Register,Reg : registers;
   Power   : boolean;

procedure Failure;
begin
    textcolor(white + blink);
    textbackground(black);
    gotoXY(12,21);
    writeln(' ********** POWER FAILURE AT REMOTE SITE ********** ');
    textcolor(white);
    textbackground(black);
end;




(* ---------------------------------------------------------------------- *)
Procedure KillCursor;
Begin
  with Save_Register do
    begin
      BH := 01;   {01}
      AH := 03;   {03}
      intr($10,Save_Register)   {save current cursor}
    end;
  with REG do
    Begin
      CH := $12;   {00}
      CL := $12;   {12}
      AH := 01;    {01}
      intr($10,REG)             {remove cursor}
    End
end;  {KillCursor}
(* ---------------------------------------------------------------------- *)
 function LeadingZero(w:word) : String;
       var  s : string;

   begin
     Str(w:0,s);
     if Length(s) = 1 then s := '0' + s;
     LeadingZero := s;
   end;

(* ---------------------------------------------------------------------- *)
Procedure RestoreCursor;
begin
 Save_Register.AH := 01;
 intr($10,Save_Register)        {restore_cursor}
end;

(* ---------------------------------------------------------------------- *)
procedure Screen;
var I            : integer;
    y,m,d,dow    : word;
  h,min,sec,hund : word;
```

```
begin
  clrscr;
  gotoXY(22,01);
  write('+---  FUEL DISP CONTROLLER  ---+');

    for I := 02 to 08 do
   begin
     delay(50);
     gotoXY(22,I);write('|');
     gotoXY(53,I);write('|');
   end;
  gotoXY(25,03);write('+----------+');
  gotoXY(25,04);write('| 00:00:00 |');
  gotoXY(25,05);write('+----------+');
  gotoXY(39,03);write('+----------+');
  gotoXY(39,04);write('| 00:00:00 |');
  gotoXY(39,05);write('+----------+');

  gotoXY(22,09);
  write('+-----+------------------+-----+');
   for I := 10 to 22 do
   begin
    gotoXY(28,I);write('|');
    gotoXY(47,I);write('|');
  end;
    gotoXY(28,23);
  write('+------------------+');
  for I := 1 to 3 do
  begin
    gotoXY(Xas,12 + I);
    write(Item[I]);
  end;
  gotoXY(56,05);write('  ----|');
  gotoXY(56,06);write('      |');
  for I := 07 to 10 do
 begin
  gotoXY(56,I);write ('      |');
  end;
 for I := 11 to 18 do
 begin
  gotoXY(48,10);write('              +---+');
  gotoXY(48,I);write ('                  |');
  gotoXY(48,19);write('------------------+');
  if Not(Power) then Failure;

    begin
     GetTime(h,min,sec,hund);
     gotoXY(41,4);
     writeln(LeadingZero(h),':',LeadingZero(min),':',LeadingZero(sec));
    end;

    begin
      GetDate(y,m,d,dow);
      gotoXY(26,4);
      writeln(y:0,'/',m:0,'/',d:0);
    end;
  end;
end;
```

```
(* ----------------------------------------------------------------- *)
procedure WriteChoice;
begin
  gotoXY(Xas,Yas + Choice);
  textcolor(black);
  textbackground(white);
  write(Item[Choice]);
  gotoXY(HXas,HYas); write(Help[Choice]);
  gotoXY(whereX - 1,whereY);
  textcolor(white);
  textbackground(black);
end;

(* ----------------------------------------------------------------- *)
procedure Up;
begin
  gotoXY(Xas,Yas + Choice);
  write(Item[Choice]);
  if Choice <> 1 then dec(Choice) else Choice := 3;
  WriteChoice;
end;

(* ----------------------------------------------------------------- *)
procedure Down;
begin
  gotoXY(Xas,Yas + Choice);
  write(Item[Choice]);
  if Choice <> 3 then inc(Choice) else Choice := 1;
  WriteChoice;
end;

(* ----------------------------------------------------------------- *)
procedure OpenPort;
begin
  CommInit(0,baud1200+noparity+onestop+len7);
end;
(* --------------------------------------------------------------- *)
function ReadRec: boolean;
begin
  {$I-}
    read(Fil,Dat);
  {$I+}
  ReadRec := (ioresult = 0);
end;
(* ------------------------------------------------------------------- *)

procedure Fuelinfo;
var
  A,B    : integer;
  Ch,
  Kch    : char;

   I     : integer;
 Data    : integer;
 TimeOut: boolean;
 Stop    : boolean;

begin
  reset(Fil);
   Stop := false;

  for I := 1 to 32000 do Net[I] := ' ';
```

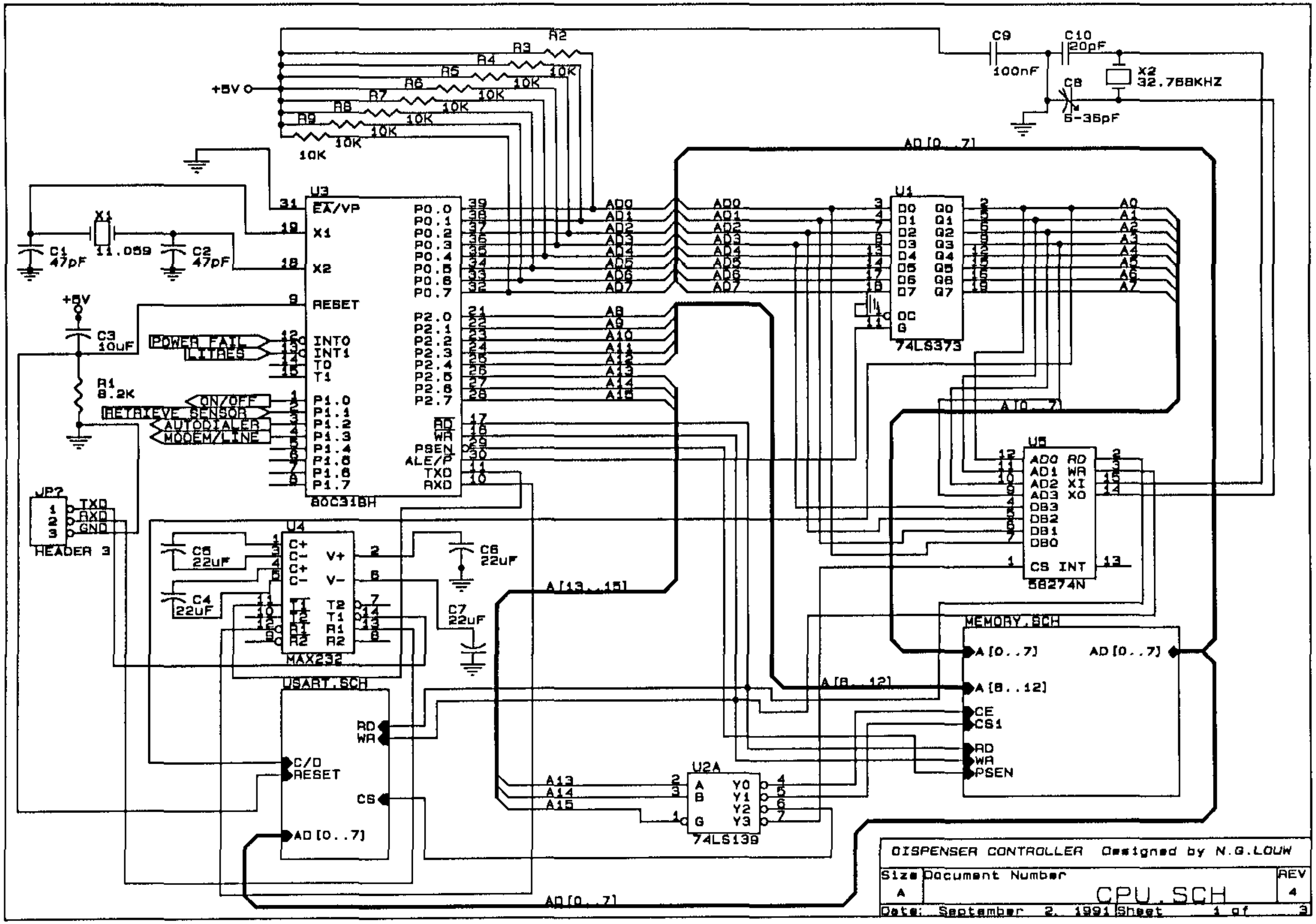
```
killcursor;
clrscr;
gotoXY(1,1);
write('+------------------------- *** FUEL CONSUMPTION DATA *** ----------------------+');
write('|                                                                              |');
write('|                                                                              |');
write('|                                                                              |');
write('|                                                                              |');
write('|                                                                              |');
write('|                                                                              |');



for I := 2 to 79 do
begin
  gotoXY(I,5);write('-');
end;
gotoXY(2,6);write('   REG NO:      | DRIVER:             | ODEO: | KM:| L:| KM/L:| TIME: | LOC:');
gotoXY(1,7);
write('+------------------------------------------------------------------------------+');

 for I:= 8 to 23 do
    begin
     gotoXY(1,I);write('|');
    end;

 for I:= 8 to 23 do
    begin
     gotoXY(80,I);write('|');
    end;

    gotoXY(1,24);
write('+------------------------------------------------------------------------------+');


  gotoXY(10,25);
  textcolor(black);
textbackground(white);
write(' Press ESC to exit                  Shft-PrtSc to PRINT !!!!');

textcolor(black);
textbackground(white);

delay (350);
textcolor(black + blink);
gotoXY(6,3);write('DATE:         ');
Datum := '';
I := 12;
repeat;
  Ch := readkey;
  gotoXY(I,3);
  I := I + 1;
  write (Ch);
  Datum := Datum + Ch;
  if I in [14,17] then
  begin
    write('/');
    Datum := Datum + '/';
    I := I + 1;
  end;
until I = 20;
textbackground(black);
```

```
  textcolor(white);
  window(2,8,78,23);
  I := 0;
  repeat
    clrscr;
    while (I < 3) and ReadRec do
    begin
      if Dat.Date = Datum then
      with Dat do
      begin
        writeln(Reg:15,Driv:20,Odeo:10,Dist:5,Litre:4,Cons:7,Time:7,Loc:6);
        inc(I);
      end;
    end;
      writeln;
      write(' *** Press any key to see more ***');
      Ch := readkey;
      I := 0;
  until Ch = #27;


  window(1,1,80,25);
  restorecursor;
end;
(* ---------------------------------------------------------------------- *)
procedure ZapZero(var Info: string);

var I   : integer;
    Tmp : string;

  begin
     Tmp  := '';
     for I := 1 to length(Info) do
     if Info[I] <> #0 then Tmp := Tmp + Info[I];
     Info := Tmp;
  end;
(* -------------------------------------------------------------------- *)

procedure Process;
var  I,
     P    : integer;
     Tmp,
     Code : integer;
     Yr,
     Mth,
     Dy   : string[2];
begin
  seek(Fil,filesize(Fil));
  for I := 1 to 10 do
   with Dat do
   begin
     Tank := copy(Data[I],1,2);
     Reg  := copy(Data[I],3,12);
     ZapZero(Reg);
     Driv := copy(Data[I],15,20);
     ZapZero(Driv);
     Supl := copy(Data[I],40,6);
     ZapZero(Supl);
     Odeo := copy(Data[I],49,6);
     {ZapZero(Odeo);}
     Dist := copy(Data[I],57,3);       {}
     Date := copy(Data[I],61,2)+'/'+ copy(Data[I],63,2)+'/'+ copy(Data[I],65,2);
     Time := copy(Data[I],67,2) +':'+ copy(Data[I],69,2);
     Cons := copy(Data[I],73,5);       {}
     Litre := copy (Data[I],78,2);
     Loc  := copy(Data[I],80,3);
     Day  := copy(Data[I],55,1);
     val(Day,Tmp,Code);
     case Tmp of
       1 : Day := 'Mon';
       2 : Day := 'Tue';
       3 : Day := 'Wed';
       4 : Day := 'Thu';
       5 : Day := 'Fri';
       6 : Day := 'Sat';
       7 : Day := 'Sun';
     end;
     val(Dat.Tank,Tmp,Code);
     if (Code = 0) then write(Fil,Dat);
   end;
end;

(* ----------------------------------------------------------------------- *)

procedure ReadCards;
var ChString : string[82];
    KCh      : Char;
    I,X,Y    : integer;
    Stop     : boolean;

begin
 { clrscr;}
  Stop := false;
  for I := 1 to 10 do Data[I] := '';
  X := 1;
  Y := 1;
  gotoXY(29,10);
  write('**  DOWNLOADING **');
  window(30,12,45,22);
  textcolor(black);
  textbackground(white);
  clrscr;
  gotoXY(1,1);
  OpenPort;
  Ch := #0;
  repeat
    if CharReady then Ch := chr(getbyte);
    if keypressed then Stop := true;
  until Stop or (Ch = #2);
  repeat
    if CharReady then
     begin
       Ch := chr(getbyte);
       if (Ch <> #3) then
       begin
          write(ch);
          Data[Y] := Data[Y] + Ch;
          inc(X);
          if X = 83 then
          begin
            inc(Y);
            X := 1;
          end;
      end;
    end;
    if keypressed then Stop := true;
  until Stop or (Ch = #3);
  Ch := #0;
   I := 0;


   repeat
    if CharReady then
     begin
       Ch := chr(getbyte);
       inc(I);
   { Ch := #7; }
     end;
       if keypressed then Stop := true;
       until (Ch = #7) or (I > 2000) or Stop;
       if (Ch = #7) then Power := false;
       textcolor(white);
       textbackground(black);

  Process;
  window(1,1,80,25);
  clrscr;
end;

(* ---------------------------------------------------------------------- *)
function PrintReady: boolean;
var Status : byte;
begin
  PrintReady := false;
  Status := port[$03BD];
  if Status = 143{223} then PrintReady := true;
end;

(* ---------------------------------------------------------------------- *)
procedure Setting;
begin
  I := 1;
  while I < 3 do
  begin
    repeat
      Ch := readkey;
    until Ch in ['0'..'9'];
    delay(250);
    Send(Ch);
    inc(i);
  end;
end;
(* ---------------------------------------------------------------------- *)
function Exist: boolean;
begin
  {$I-}
    reset(Fil);
  {$I+}
  Exist := (ioresult = 0);
end;

(* ---------------------------------------------------------------------- *)
begin
   Power := true;
   assign(Fil,'a:Fuel.Dat');
   if Exist then reset(Fil) else rewrite(Fil);
   clrscr;
  KillCursor;
  textcolor(white);
  textbackground(black);
  Choice := 1;
  repeat
    Screen;
    WriteChoice;
    repeat
      Ch := readkey;
      case Ch of
        #72 : Up;
        #80 : Down;
      end;
    until Ch = #13;
    case Choice of
      1 : FuelInfo;
      2 : ReadCards;
      end;
  until Choice = 3;
  clrscr;
  RestoreCursor;
  close(Fil);
end.
```

APPENDIX D.

Circuit Diagrams.

INDEX.



DISPENSER CONTROLLER Designed by N.G.LOUW

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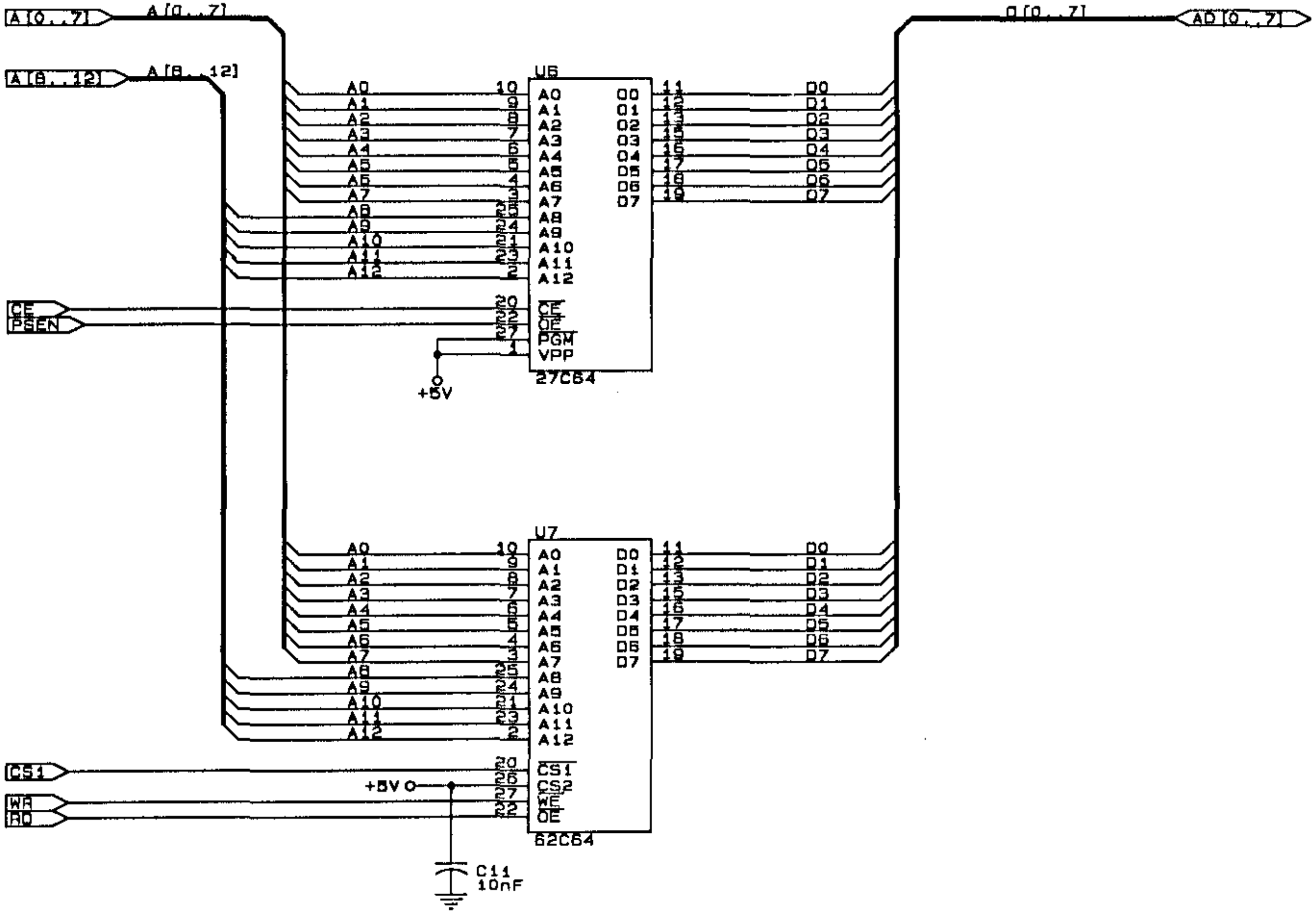
Date: September 2, 1991 Sheet 1 of 3



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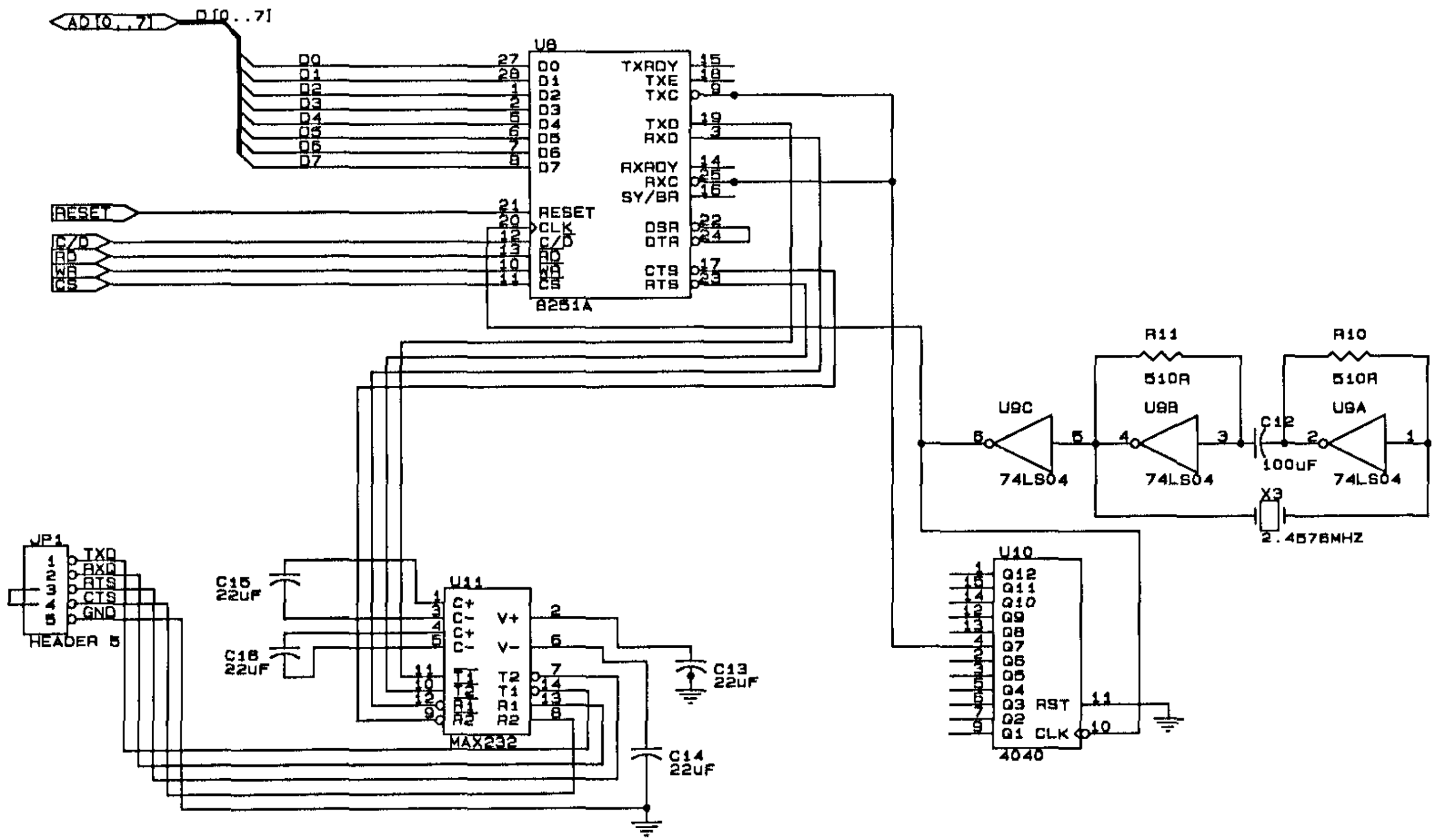

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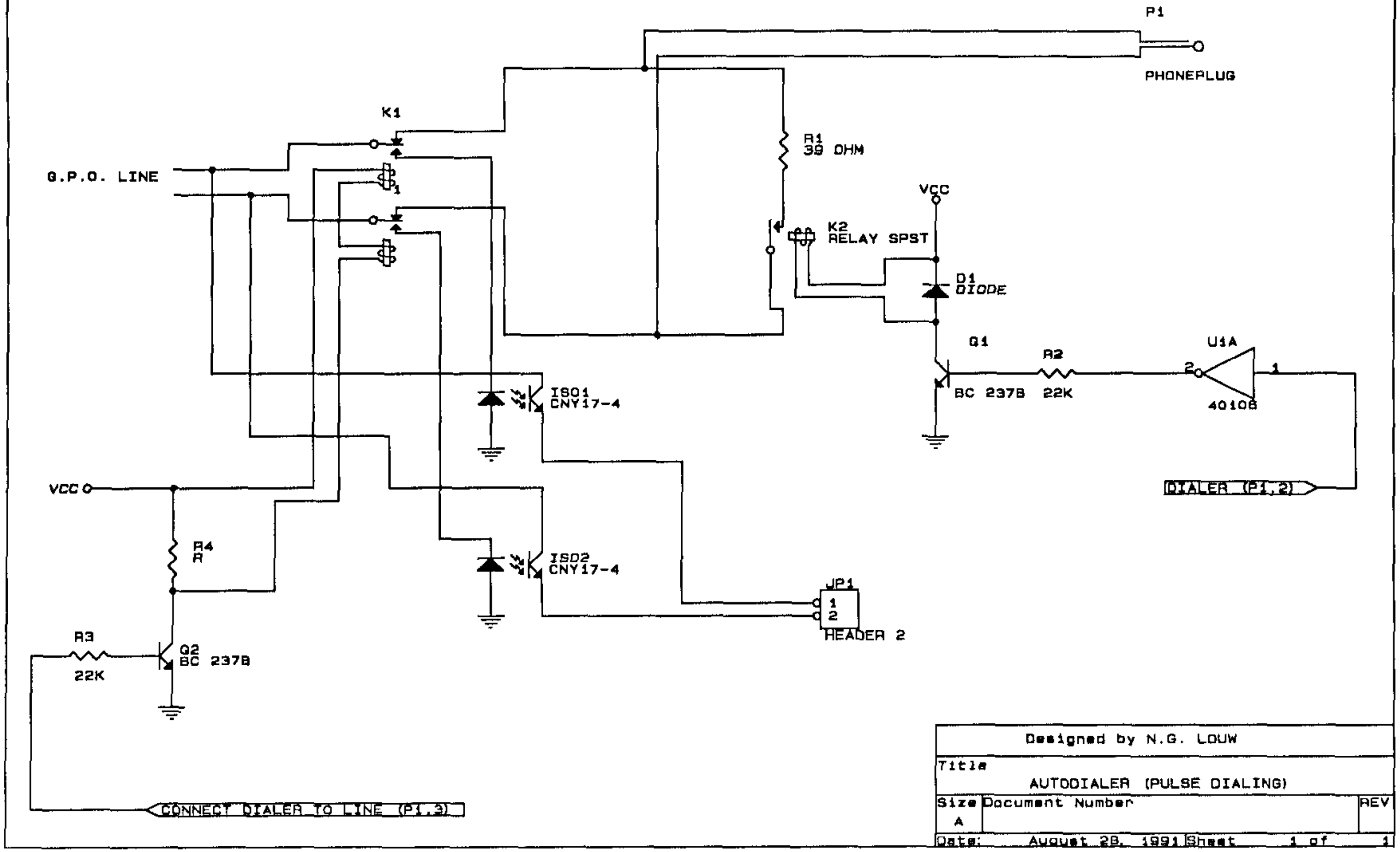

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AUTODIALER (PULSE DIALING)

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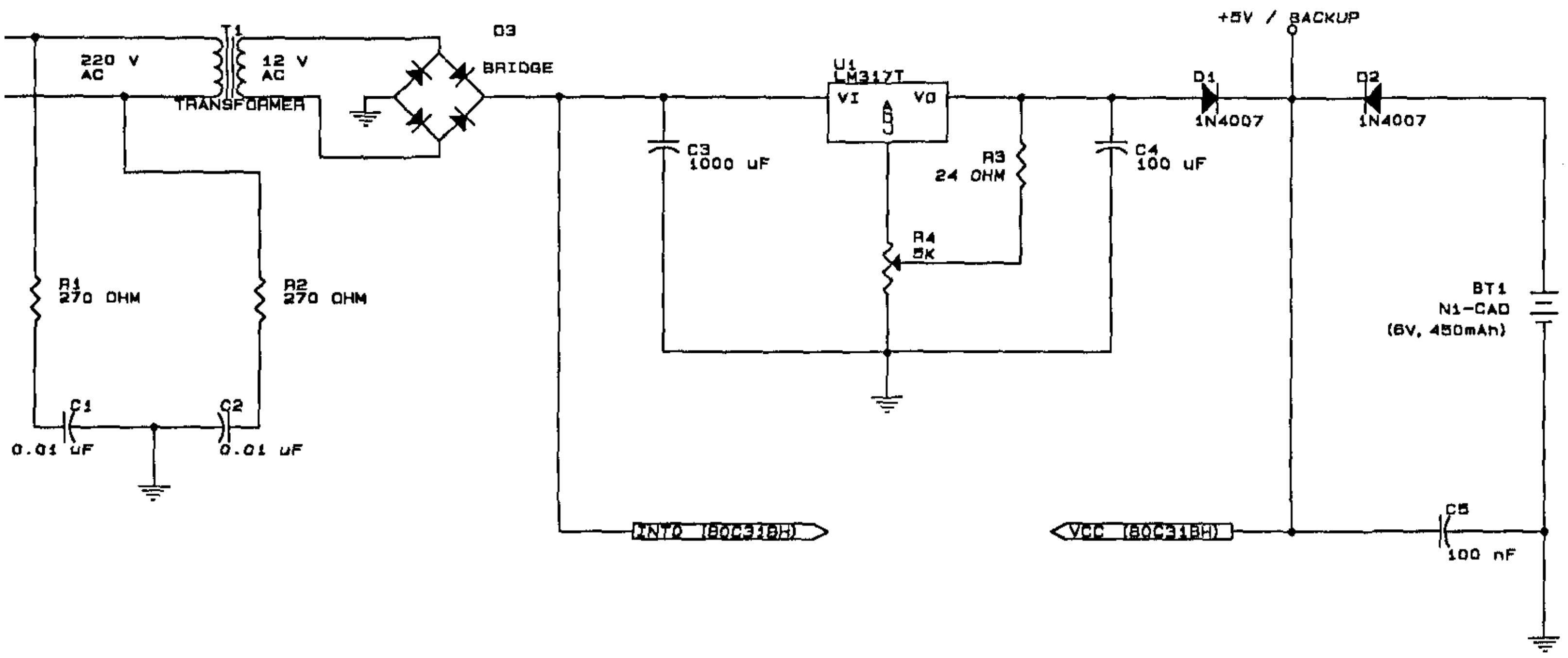

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