Microlab - ServiceManual

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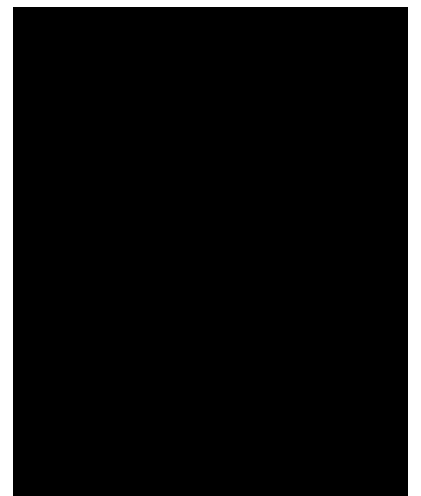
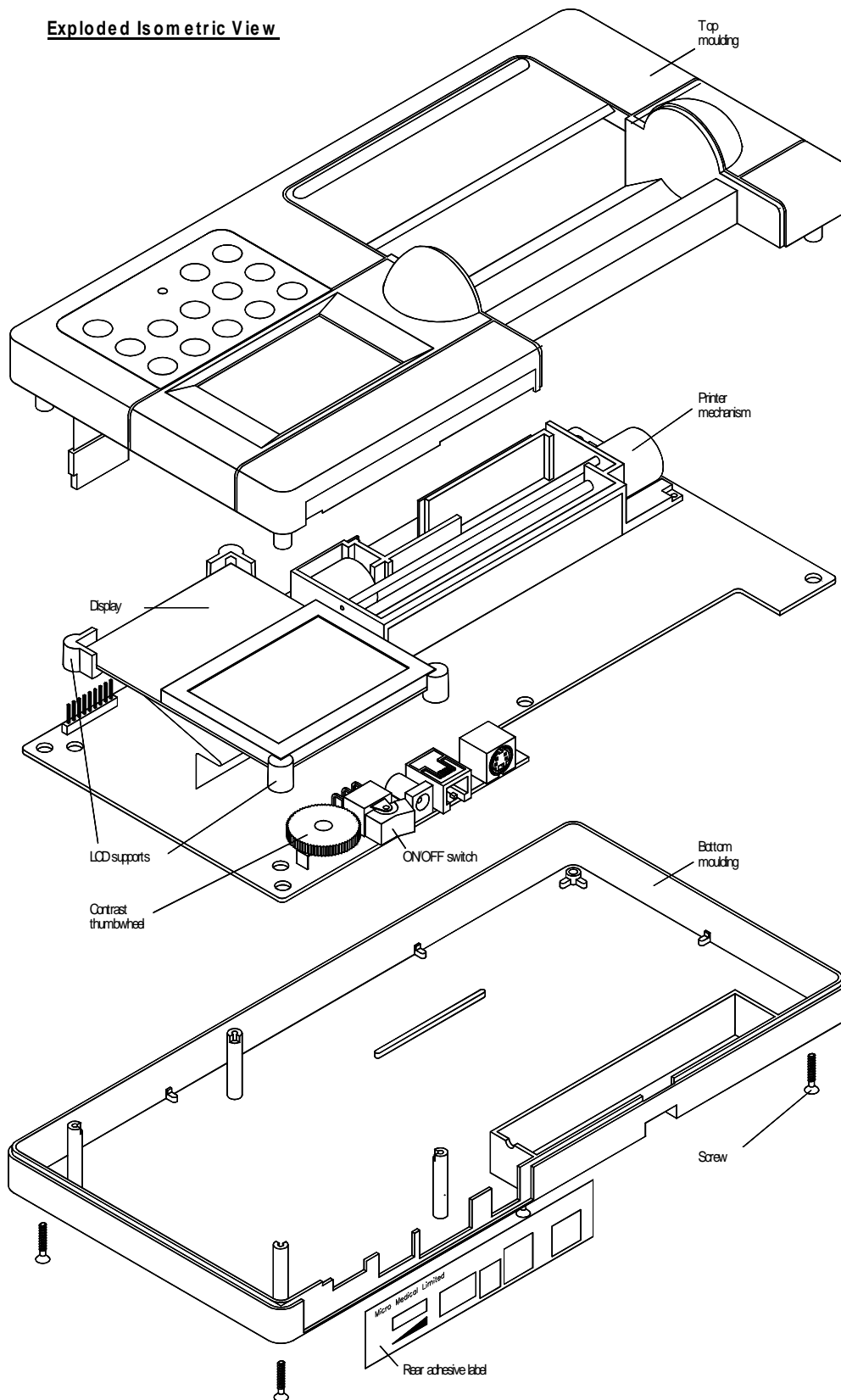# Contents

Exploded Isometric View

Top moulding

Printer mechanism

Display

LCD supports

ON/OFF switch

Contrast thumbwheel

Bottom moulding

Screw

Micro Medical Limited

Rear adhesive label

MicroLab - System Overview (Fig. 1)

The Micro Medical MicroLab is a data recording spirometer consisting of a microcomputer unit (1) incorporating an LCD graphic display, data entry keypad, RS232 serial interface and all associated circuitry. This is supplied with a digital volume transducer (2), disposable mouthpieces, transducer holder (3) and mains adapter (4). The MicroLab is powered by internal rechargeable Nickel Cadmium cells or by the mains adapter supplied (4).

When testing a subject the transducer is inserted into the holder which is plugged into the microcomputer unit. The digital volume transducer is used to measure the subjects expired flow and volume in accordance with the operating manual.

Fig. 1
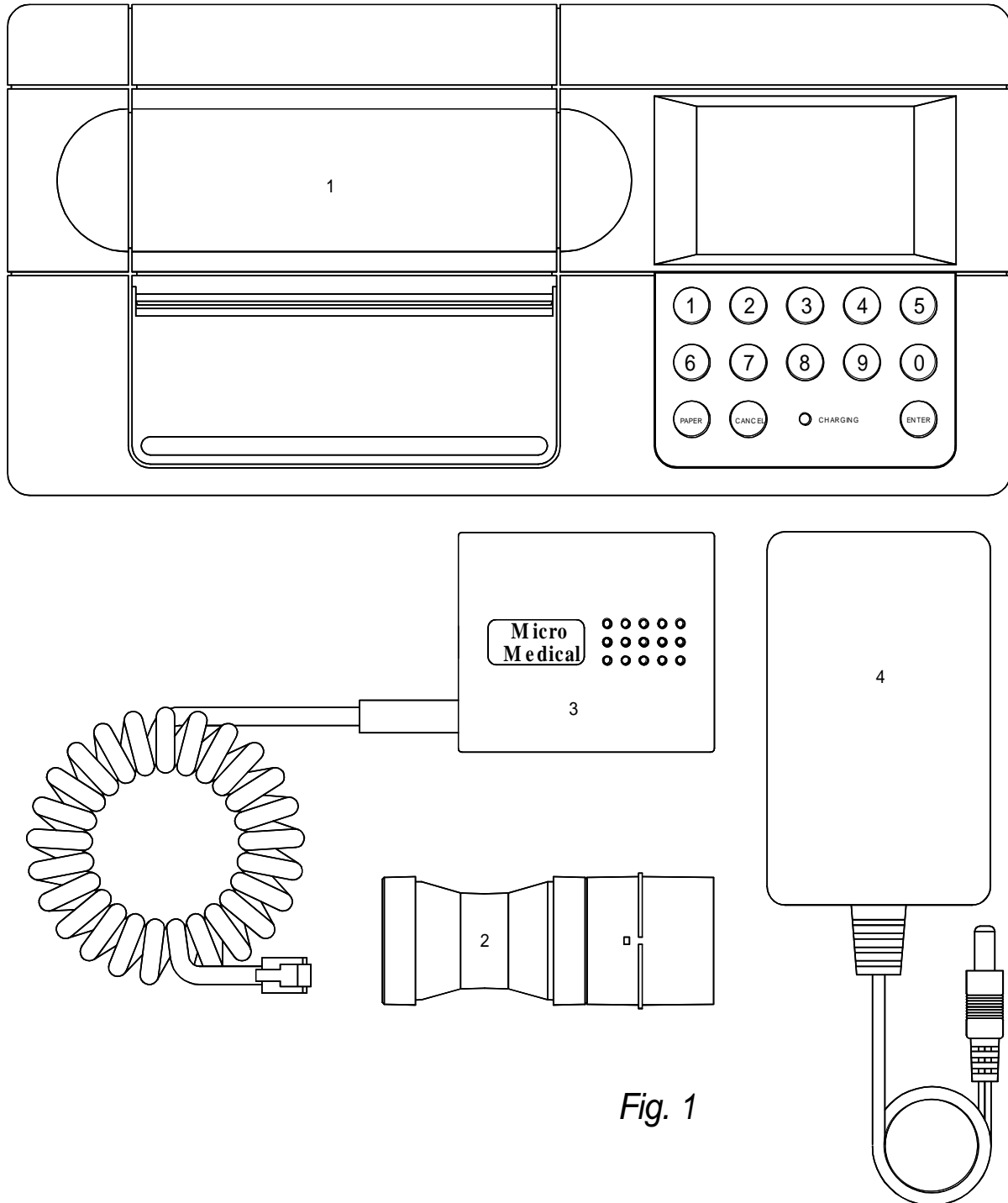
Transducer (Fig. 2)

The Micro Medical digital volume transducer consists of an acrylic tube with a vane positioned between two swirl plates. The low inertia vane is attached to a stainless steel pivot which is f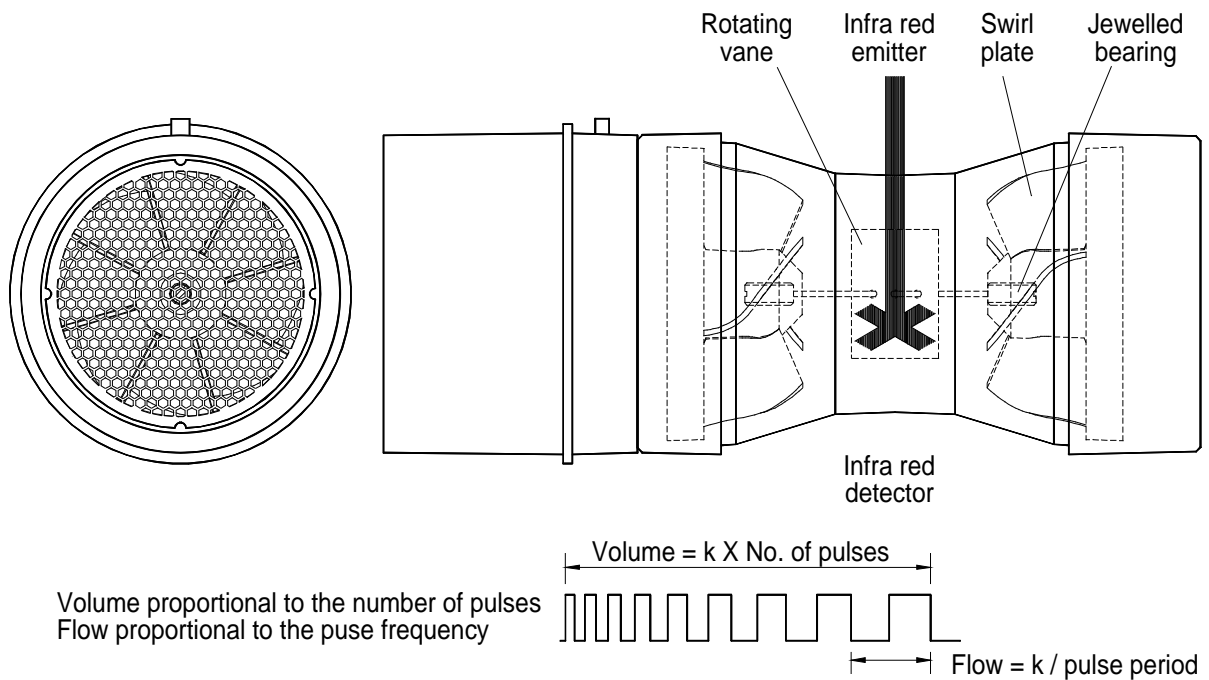ree to rotate on two jewelled bearings mounted at the centre of the swirl plates. As air is passed through the transducer a vortex is created by the swirl plates which causes the vane to rotate in a direction dependant upon the direction of air flow. The number of rotations is proportional to the volume of air passed through the transducer and the frequency of rotation is proportional to the flow rate. The transducer housing consists of a main body which contains a pair of light emitting diodes (LED's) and phototransistors. The transducer is fixed to the mouthpiece holder which pushes into the main body and is captured by an "O" ring seal. The LED's produce infra red beams which are interrupted by the vane twice per revolution. This interruption is sensed by the phototransistors. The output from the collector of each phototransistor will be a square wave with a phase difference between the two of + or - 90 degrees depending upon the direction of flow.

There is no routine maintenance required for the transducer other than cleaning according to the instructions in the operating manual.

Micro Medical Digital Volume Transducer

Rotating vane   Infra red emitter   Swirl plate   Jewelled bearing

Infra red detector

Volume = k X No. of pulses

Volume proportional to the number of pulses
Flow proportional to the puse frequency

Flow = k / pulse period

5

Disassembing the Microlab for Repairs

1. Disconnect all mains power supplies
2. Remove paper roll and paper roll housing cover, and put to one side
3. Remove the rear adhesive label and disregard.
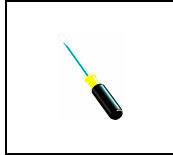
	We recommend that you use a Philip Number Zero screwdriver for the following instruction.

4. Place the Microlab face down to remove the five screws in the lower moulding, and put the screws to one side.
5. Turn the unit face up before easing the upper and lower mouldings apart.
6. Ease the LCD display printed circuit board out of its plastic supports and rest inside of upper moulding and remove LCD supporting corners and put to one side.
7. Reconnect mains power supply
8. The Microlab is now ready for Fault Finding.

	If you are not familiar with the operation of the Microlab please read the following section in this manual 'Circuit Description' and use the Circuit diagrams at the back of this manual.

Circuit Description

Overview

The microprocessor control circuit carries out the spirometry routines, monitors the transducer pulses and keypad, and drives the display under the control of the program stored in the battery backed RAM.

The power supply uses the mains adapter, internal Nickel-Cadmium (Ni-Cad) cells and an internal lithium backup as its sources of energy. The supply provides 5 volts to the control circuit, -12 volts supply for the display and RS232 driver circuit, 3 volts RAM backup, controls the charging current to the Ni-Cad battery pack, and provides for battery management.

The microprocessor (IC1) communicates with the real time clock (IC6), the output latch (IC5), and the display under the control of the program, stored in the RAM (IC2), using a multiplexed address and data bus decoded by a data latch (IC3). The RAM, which is used both for program storage and for temporary data storage, has a memory map which is partitioned by the action of the PAL (IC4) into writable and non-writable areas.

Processor Control Section (043-01)

Address bus

The microprocessor (IC1) uses a multiplexed address bus. The lower order address lines are latched into IC3 with the address strobe (AS).

The program for the microprocessor (IC1) is stored in a 128kByte, battery backed static ram, (IC2). As the address space of the processor is limited to 64kBytes the ram address space is paged using a programmable array logic device (IC4). This device decodes address lines A1, A13, A14, A15, port lines PD5, PA4, control line R/W, clock signal E, mode control lines MODA, MODB, and the external reset line to provide the following outputs:

RAM address lines A15 and A16

Chip select lines (CS) for the display and latch (IC5)
Write enable (WR) for display, latch, and RAM
Read enable (RD) for the display
Output enable (OE) for the RAM

Reset

The reset circuit consists of a single chip reset (IC9) which holds the reset line (RES) low for 350ms after the 5 volt supply has reached the threshold voltage of 4.5 volts. The reset signal is applied to the microprocessor (IC1), display, programmable array logic device (IC4), and the printer driver processor (IC17).

Keypad

The keypad consists of a matrix of 12 keys (0 to 9, CANCEL, and ENTER) together with a separate paper feed key (PAPER). The matrix is read by successively asserting (5 volts) the columns of the matrix and reading the state of the rows to determine which key has been pressed. The microprocessor asserts the columns by writing to the latch (IC5) and reads the rows directly on port E (PE4 to PE7). The diode (D2) prevents current flowing from an asserted line of the latch to one at 0 volts in case of two keys on the same row being depressed simultaneously. The resistor network (RN1) biases the PE4 to PE7 to 0 volts.

Real Time Clock

The real time clock (IC6) is set by the processor during the factory set-up and should not require any further adjustment. The processor communicates with the real time clock (RTC) with a serial interface line to pin 5 of the RTC. The RTC is selected by the signal from pin 12 of the output latch (IC5).

Display

The display is a custom graphic 128 by 64 dot LCD with in-built control circuitry. The contrast is adjusted by varying the voltage on pin 3 between -4 and -12 volts with VR1. This potentiometer varies the output of the voltage inverter, IC12.

Serial interface

The microprocessor communicates with the integral printer and the external RS232 port using its serial communications interface. Serial information from the microprocessor is switched to either the printer driver or the external RS232 port under the control of the signal appearing on pin 9 of the latch (IC5). This signal controls the switching logic of IC10 and IC8. The serial output from the microprocessor, TXD, is applied to the input of IC10. Depending upon the state of the control signal, the serial information will either pass through IC10 to the printer controller (IC17), or through the level converter (TR4, and R22) to the external RS232 port.

Battery monitoring

The microprocessor contains eight, 8 bit analogue to digital converters. One of these, AN3 is used to monitor the condition of the main supply (BAT1). The main supply is monitored at the input to the logic 5 volt regulator (IC11) and the user will be alerted to a low battery condition when the voltage falls below 6 volts. The voltage is divided by two with R8 and R9 to bring the voltage within the range of the A/D converter (5 volts). AN3 also detects when the external power supply has been applied. One end of R10 is pulled to 0 volts when the external supply is not applied and the voltage read on the A/D converter will be up to 4 volts for a fully charged battery. With the external supply applied, the voltage will rise above 5 volts.

Printer Driver (Drawing 043-02)

The printer driver uses a single chip micro-controller (IC17) with on board program memory and RAM to receive serial data from the microprocessor (IC1) and control the printer mechanism. The printer mechanism uses stepper motors to drive the print head and paper feed. Each stepper motor uses four lines, driven sequentially. The order of in which the lines are driven determines the direction of rotation. The thermal print head uses eight heater elements. The stepper motors and print head signals are generated on port A and B (active high) of the micro-controller (IC17). The signals pass through two octal high current Darlington drivers (IC19 and IC20). Timing for Port A and B is derived from an adjustable oscillator comprising of IC18, R28 to R33, C15, D8 and VR2. Adjusting VR2 varies the oscillator frequency and consequently the period for which the thermal elements are energised. This in turn adjusts the print density. After the micro-controller is first reset, the print head is driven to the left until the end switch is activated. The end switch consists of a normally closed pair of contacts accessed at pins 1 and 2 of the printer connector, PL1. The end switch is detected by PD5 on the micro-controller.

Power Supply

External power input, 5 volt logic and −12 volt supply (Drawing 043-01)
The external power input is applied through SK4. Power is applied to the NI-Cad charging circuit and a 9 volt regulator (IC7) through a reverse polarity protection diode, D4. The charging circuit consists of R4, R7, TR6, and D1. These components are in a constant-current configuration and supply a nominal 60mA to the Ni-Cad battery pack (BAT1). The charging indicator (LED1) is driven from the output of IC7 through R5. BAT1 is isolated from the circuit during charging by the action of D6, which ensures that only the regulated output of IC7 can supply power when the external power supply is connected. Power is supplied to the circuit when SW1 is switched, turning on the series pass transistor TR5. TR5 can also be held on by the microprocessor through TR2 connected to PA5 of IC1. This feature is used by the program to ensure integrity of data during periods of writing to the RAM when the user may turn the unit off. The output of TR5 is filtered by R40 and C43 and used as an unregulated power supply for IC26, IC29 and, IC27. All logic circuitry has 5 volts supplied from a low drop-out regulator, IC11. The display requires a negative bias voltage and this is produced by the −12 volt generator (IC12, C5, C6, D10, C7, and D7). Display contrast is adjusted by varying the negative bias through the accessible VR1.

Printer mechanism supply (Drawing 043-02)

6 volts (VP) is supplied to the printer mechanism from the low drop-out, high current regulator, IC16. The input to IC16 comes from the Ni-Cad battery pack or external power supply through SW1.

Transducer interface

The supply to the two series LEDs inside the transducer housing is provided through TR3. This is controlled by port pin PA3 of the processor and is only turned on during a spirometry manoeuvre to conserve power. However, power is supplied to the transducer through D5 continuously when the mains adapter is connected.
Inside the transducer housing the two phototransistors used to detect the interrupted infra-red beam are in open collector configuration. The collectors are connected to pins 2 and 3 of SK2. The pull up resistor for the phototransistor connected to pin 2 is provided by R18 and R21. The pull up resistor for the other phototransistor is provided by R19 and R20. The signals from the phototransistors are applied to the pulse timing input of the processor (pin 32) and a general purpose port pin 33 after being squared up by the action of the schmitt inverters IC8 A and B. The rising edge of the signal applied to pin 32 causes an interrupt to be generated in the processor. This interrupt is processed by incrementing a pulse count, timing the period since the last pulse and by reading the state of pin 33. The pulse count is used to determine the volume passed through the transducer since the start of the test and the pulse period is used to determine the flow at each volume increment. The state of pin 33 at the time of the interrupt determines the direction of flow.

Parts List

Designation	Description
IC1	**(MC68HC11E1FN)** MICROCONTROLLER
IC2	**(KM681000BLG/BLG-L)** SAMSUNG 1 MEG SURFACE MOUNT STATIC RAM 55 TO 150nS ACCESS TIME
IC3	**(74HC573)** SURFACE MOUNT OCTAL LATCH
IC4	**(PALCE16V8Z25PC)** AMD ZERO POWER CMOS PLD DIP PACKAGE
IC5	**(74HC273)** SURFACE MOUNT OCTAL D FLIP-FLOP
IC6	**(PCF8583T)** PHILIPS SURFACE MOUNT CLOCK CALENDER WITH 256 BYTE RAM
IC7	**(LM2940T-9.0)** LOW DROP OUT 9 VOLT 1 AMP REGULATOR
IC8	**(74HC14)** SURFACE MOUNT HEX SCHMITT INVERTOR
IC9	**(DS1233D-10)** DALLAS ECONO RESET
IC10	**(74HC32)** SURFACE MOUNT QUAD TWO INPUT OR GATE
IC11	**(LM2931M-5.0)** LOW DROP OUT 5 VOLT 100mA SURFACE MOUNT REGULATOR
IC12	**(LT1054CS8)** SURFACE MOUNT VOLTAGE CONVERTOR
IC13	**NOT USED**
IC14	**NOT USED**
IC15	**(BU4S11)** OR **(BU4S01)** RHOM INDIVIDUAL CMOS GATE
IC16	**(LT1084CT)** LOW DROP OUT ADJUSTABLE VOLTAGE 5 AMP REGULATOR
IC17	**(MC68HC705/C8FN)** MOTOROLA OTP MICROPROCESSOR
IC18	**(4069UB)** SURFACE MOUNT UNBUFFERED HEX INVERTOR
IC19	**(ULN2803LW)** 8 DARLINGTON SURFACE MOUNT ARRAY - ALTERNATIVE **(TD62083AF)**
IC20	**(ULN2803LW)** 8 DARLINGTON SURFACE MOUNT ARRAY - ALTERNATIVE **(TD62083AF)**
R1	100K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R2	1M SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R3	100K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R4	1OHMS SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R5	330 OHMS SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R6	1K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R7	1K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R8	100K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R9	100K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R10	100K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R11	10K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R12	1K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R13	1K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R14	33K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R15	330K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R16	10K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R17	10K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R18	4.7K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R19	4.7K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R20	3.3K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R21	3.3K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R22	3.9K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R23	1K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R24	100 OHMS SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R25	1M SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R26	120 OHMS SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R27	470 OHMS SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R28	100K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R29	1K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R30	22K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R31	2.2K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206

R32	150K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R33	22K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R34	1M SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R35	10K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R36	1K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
R37	100K SURFACE MOUNT RESISTOR 0.125 WATT 5% SIZE 1206
RN1	4 WAY COMMONED 10K SIL NETWORK
VR1	**(T18 S/I S/B S/T 20KA)** PHIER 20K LINEAR POTENTIOMETER
VR2	**(3204X203P)** MEC CITEC SINGLE TURN 20K SURFACE MOUNT PRESET
C1	RUBYCON 22uF 35 VOLT ELECTROLYTIC CAPACITOR TYPE 35MH522M0563
C2	RUBYCON 47uF 16 VOLT ELECTROLYTIC CAPACITOR TYPE 16MH547M6357
C3	RUBYCON 47uF 16 VOLT ELECTROLYTIC CAPACITOR TYPE 16MH547M6357
C4	RUBYCON 47uF 16 VOLT ELECTROLYTIC CAPACITOR TYPE 16MH547M6357
C5	RUBYCON 47uF 16 VOLT ELECTROLYTIC CAPACITOR TYPE 16MH547M6357
C6	RUBYCON 47uF 16 VOLT ELECTROLYTIC CAPACITOR TYPE 16MH547M6357
C7	RUBYCON 47uF 16 VOLT ELECTROLYTIC CAPACITOR TYPE 16MH547M6357
C8	RUBYCON 47uF 16 VOLT ELECTROLYTIC CAPACITOR TYPE 16MH547M6357
C9	10nF PHILIPS SURFACE MOUNT CERAMIC CAPACITOR SIZE 1206
C10	15pF PHILIPS SURFACE MOUNT CERAMIC CAPACITOR SIZE 1206
C11	10nF PHILIPS SURFACE MOUNT CERAMIC CAPACITOR SIZE 1206
C12	10nF PHILIPS SURFACE MOUNT CERAMIC CAPACITOR SIZE 1206
C13	33pF PHILIPS SURFACE MOUNT CERAMIC CAPACITOR SIZE 1206
C14	33pF PHILIPS SURFACE MOUNT CERAMIC CAPACITOR SIZE 1206
C15	820pFF PHILIPS SURFACE MOUNT CERAMIC CAPACITOR SIZE 1206
C16	RUBYCON 47uF 16 VOLT ELECTROLYTIC CAPACITOR TYPE 16MH547M6357
C17	RUBYCON 47uF 16 VOLT ELECTROLYTIC CAPACITOR TYPE 16MH547M6357
C18	100nF PHILIPS SURFACE MOUNT CERAMIC CAPACITOR SIZE 1206
C19	33pF PHILIPS SURFACE MOUNT CERAMIC CAPACITOR SIZE 1206
C20	33pF PHILIPS SURFACE MOUNT CERAMIC CAPACITOR SIZE 1206
C21	1nF PHILIPS SURFACE MOUNT CERAMIC CAPACITOR SIZE 1206
C22	1nF PHILIPS SURFACE MOUNT CERAMIC CAPACITOR SIZE 1206
CD (x8)	100nF PHILIPS SURFACE MOUNT CERAMIC CAPACITOR SIZE 1206
TR1	**(DTC114EK)** RHOM NPN DIGITAL TRANSISTOR
TR2	**(DTC114EK)** RHOM NPN DIGITAL TRANSISTOR
TR3	**(DTB113EK)** RHOM PNP DIGITAL TRANSISTOR
TR4	**(DTA114EK)** RHOM PNP DIGITAL TRANSISTOR
TR5	**(FMMT591)** ZETEX PNP TRANSISTOR - SOT23
TR6	**(2SB1189)** RHOM PNP TRANSISTOR - MPT (SOT89)
TR7	**(FMMT491)** ZETEX NPN TRANSISTOR – SOT23
LED	**(HLMP6400)** HP YELLOW LED
D1	**(IMN10)** RHOM 3 DIODE ARRAY - IMD PACKAGE
D2	**(IMN10)** RHOM 3 DIODE ARRAY - IMD PACKAGE
D3	**(IMN10)** RHOM 3 DIODE ARRAY - IMD PACKAGE
D4	**(S1NB20)** SHINDENGEN 1A BRIDGE RECTIFIER
D5	**(1SR154-400)** RHOM 1A DIODE - PSM PACKAGE. ALTERNATIVE SHINDENGEN **(D1F20)**
D6	**(DE5SC4M)** SHINDENGN 5A DUAL SHOTTKY DIODE
D7	**(S1ZAS4)** SHINDENGN 1.2A DUAL SHOTTKY DIODE
D8	**(BAS19)** SMALL SIGNAL DIODE SOT23 PACKAGE
D9	**(ZHCS750)** ZETEX SMALL SIGNAL SHOTTKY DIODE SOT23 PACKAGE
D10	**(ZHCS750)** ZETEX SMALL SIGNAL SHOTTKY DIODE SOT23 PACKAGE
L1	**(NLC565050T-3R9K)** TDK 3.9uH SURFACE MOUNT INDUCTOR
L2	**(NLC565050T-3R9K)** TDK 3.9uH SURFACE MOUNT INDUCTOR
DISPLAY	**(DMF-50424N)** OPTREX 128 X 64 GRAPHIC DISPLAY
PRINTER	**(STP411B-320)** SEIKO THERMAL PRINTER MECHANISM
SW1	**(SW246A6+U622)** MORS DOUBLE POLE ROCKER SWITCH

SK1	**(MDS4)** 4 WAY MINI DIN SOCKET
SK2	**(95001-2611)** MOLEX 6 WAY DATA SOCKET
SK3	9 WAY PIN HEADER
SK4	**(MJ-179P)** DC POWER SOCKET
SK5	**(B 3B-PK)** 3 WAY PCB SOCKET FROM JST
PL1	PRECI-DIP 10 WAY TURNED PIN RIGHT ANGLE PLUG
PL2	PRECI-DIP 14 WAY TURNED PIN RIGHT ANGLE PLUG
SPKR	**(PKM35-4A0)** MURATA PIEZO CERAMIC SOUNDER
X1	4.9152MHz CRYSTAL CAN STYLE HC49/4H
X2	32.768KHz CRYSTAL
X3	4MHz CERAMIC RESONATOR
BAT1	NI-CAD BATTERY PACK - 6 X AAA CELLS
BAT2	**(CR2040)** 280mA-Hr 3V LITHIUM PCB MOUNTED BATTERY

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Fault Analysis

The following analysis is only a guideline and should be carried out in a logical sequence. If the fault is still apparent after the following suggestions then the unit should be fault found using the circuit descriptions and circuit diagrams provided.

When the unit is turned on there is no display present

-Rotate contrast thumb wheel anti-clockwise to see if screen darkens.
-Connect charger to see if screen darkens and charging light illuminates.

When the unit is turned on the display is dark purple

-Rotate contrast thumb wheel clockwise to see if screen colour becomes lighter and characters are displayed.
-Connect charger to see if screen characters appear.

FVC readings are low

-Remove Turbine from Transducer housing. Taking the Turbine, move it uniformly through the air and check that the vane is not sticking.

The unit does not record any blows

-Inspect Transducer housing connector for damage.
-Check that Transducer housing lead is properly connected to SK2.
-Remove Turbine from Transducer housing. Taking the Turbine, move it uniformly through the air and check that the vane is not sticking.
-Blow into Transducer housing and move Transducer head cable around to check for breaks in the cable.
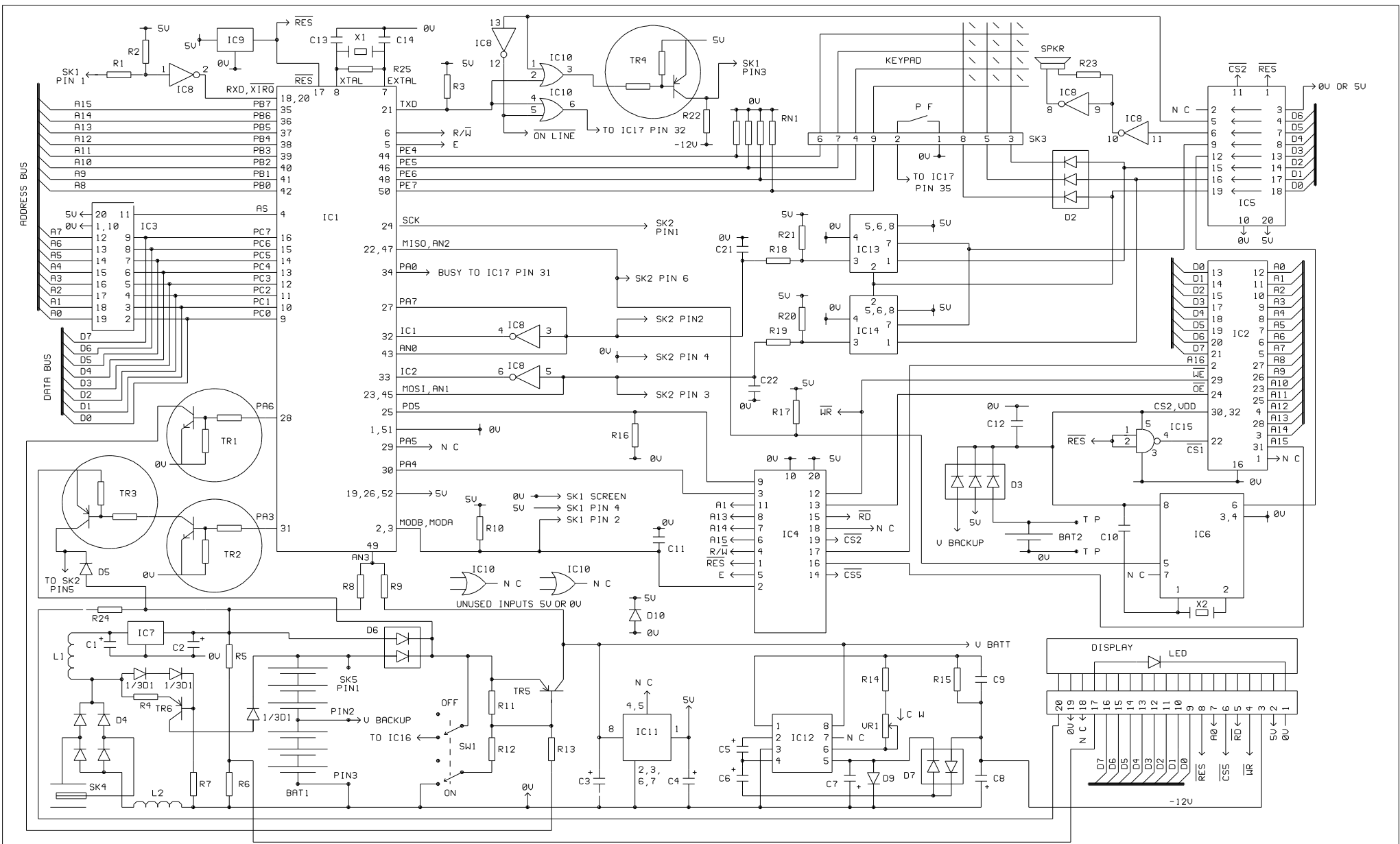
DRAWN C P L	TITLE ML3300 PROCESSOR SECTION	ISSUE	DATE	DESCRIPTION OF MOD	DATE	DESCRIPTION OF MOD
DATE 1/12/97	DRAWING No 043-01	1 2				

TO SW1   3   IC16   2,TAB   UP
C16   1   R26   C17
R27
0V

PF   35(PD3)
RES   1 (RESET)

ON LINE   36(PD4)
BUSY TO IC1 PIN 34   31(PC0)
TO IC10   32(PD0/RDI)
N C   3,23,25,26,27
28,29,30,33,41
0V   22,34,38,39,40
5V   4,44

IC17

37(PD5)

(PA7) 5
(PA6) 6
(PA5) 7
(PA4) 8
(PA3) 9
(PA2) 10
(PA1) 11
(PA0) 12

(PB0) 13
(PB1) 14
(PB2) 15
(PB3) 16
(PB4) 17,18
(PB5) 19
(PB6) 20
(PB7) 21

IC19
IC20
IC19
IC20

IC19
IC19
IC20
IC20

5V
R35   R36   C18   0V
PL1
1
2
3
4
5   Ø1
6   Ø2   HEAD
7   Ø3   MOTOR
8   Ø4
9
10   UP
11   Ø1
12   Ø2   PAPER FEED
13   Ø3   MOTOR
14   Ø4
N C-15

PL2
16   N C-
17   DOT1
18   DOT2
19   DOT3
20   DOT4
21   DOT5
22   DOT6
23   DOT7
24   DOT8
25   UP

UP
IC18   14
13   12   N C
7
0V
0V

C15   IC18   IC18
11   10 9   8   R29   24(PC7)
2 (IRQ)

R28   IC18   IC18   IC18
1   2   3   4   5   6
R30   TR7   R31
R32   VR2   R33
D8

42   43
R34
X3
C19   C20
0V