MicroLab
Service Manual

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
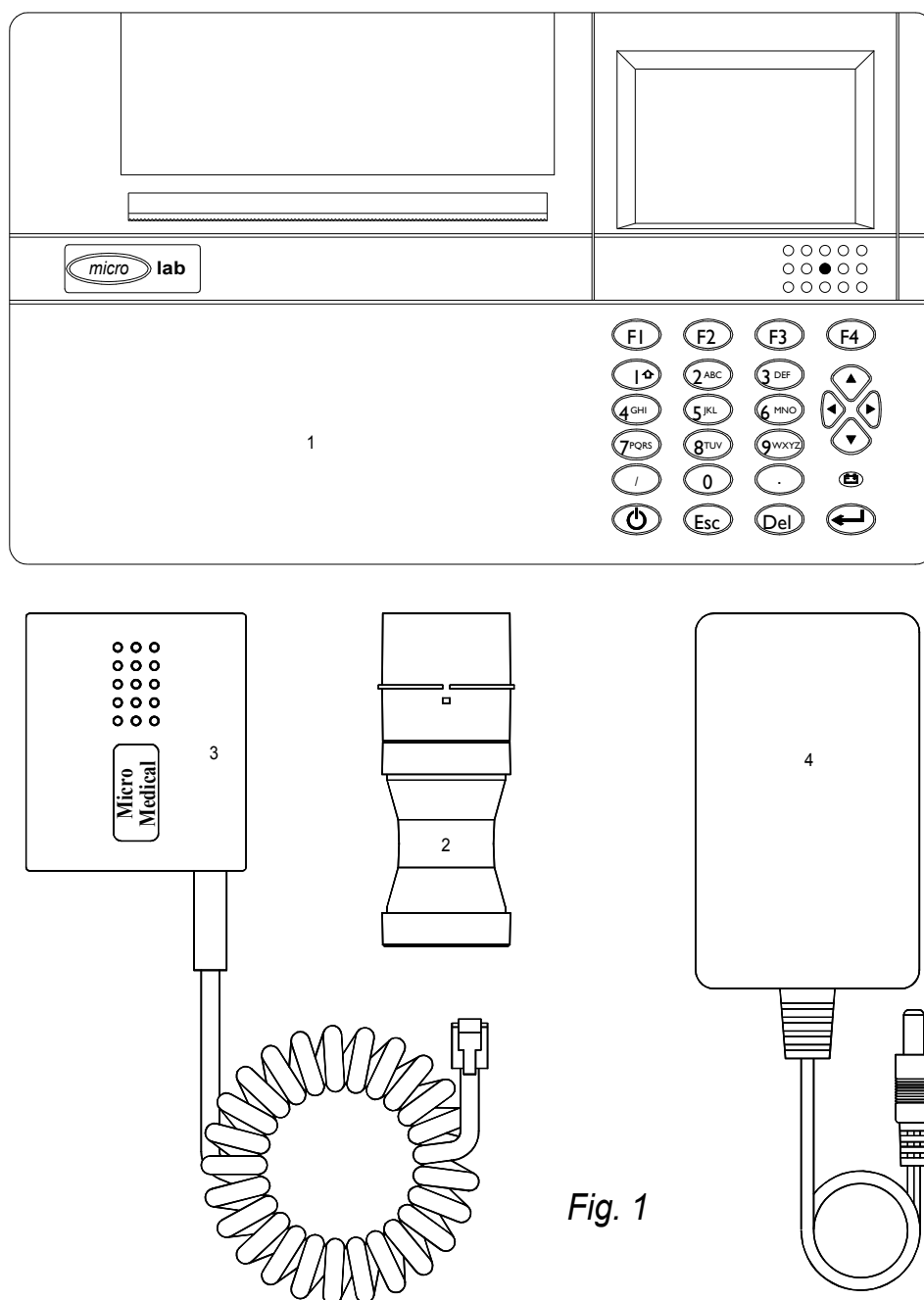
Transducer (Fig. 2)

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 free 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

3
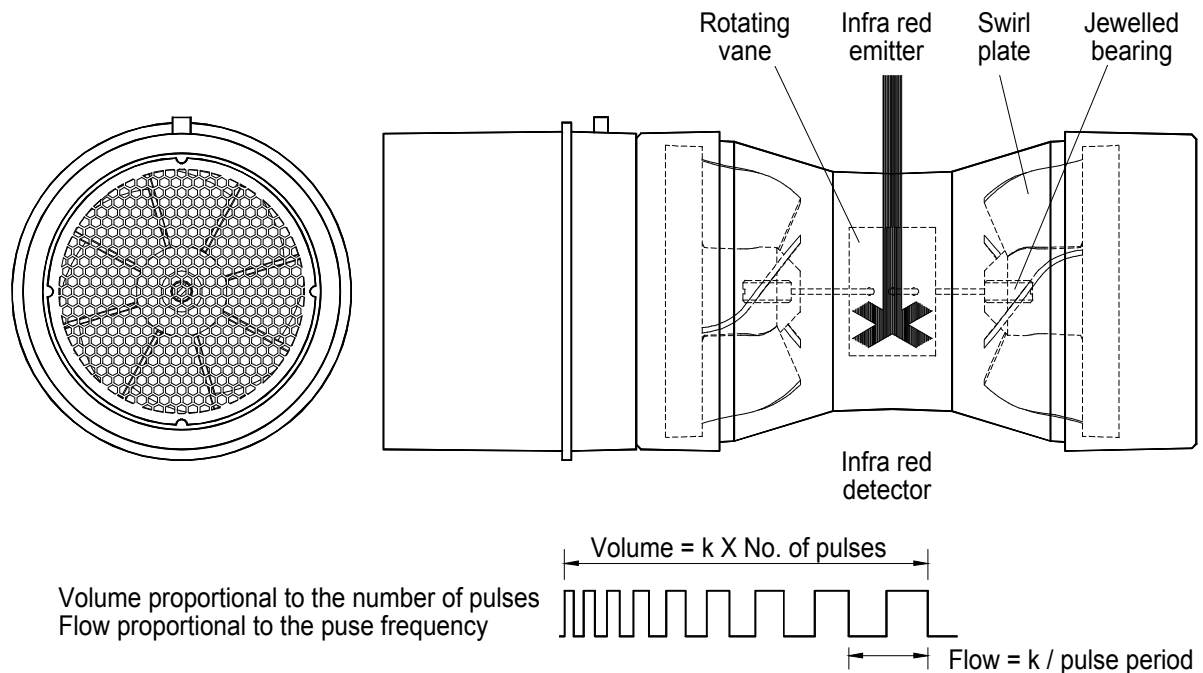
Microcomputer Unit
(Refer to drawings 069-01 to 069-06, and 069-14 to 069-12)

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 module.
The drawing 069-01 is a hierarchical block diagram showing the connections of the sub-sections. The rest of the drawings are sub-sections and are described in detail below.

Micro controller (069-02).

U2 is a Hitachi HD64F2318 16 bit microprocessor with 256K of flash memory and 8K of Ram. The system clock is supplied by 20MHz crystal (X1). There is also 512 Kbyte (U4) of external Ram used for running a module and storing variable data. The internal flash is used for the boot software, kernel and the base module. The kernel handles the low level interface to display, keyboard etc. and the base module runs on start-up and gives a choice of which module needs to be executed.

The modules are stored in the external 8 Mbyte Flash PROM (U5). The kernel also has a flash filing system which keeps track of all the files in the external Flash PROM. The files can be an executable module or spirometry or other module data. The filing system is similar to the old PC Dos filing system.

U6 is just used to control the access to the flash device.

The speaker J2 is directly connected to the Port pins and the pins are toggled at 1 KHz to generate the buzzing sound.

U2 is used for enabling the internal flash to be overwritten. If a new kernel is downloaded, the flash is enabled and data transferred.

U1 is the reset controller, which holds the reset line low for 350 ms on power up. This ensures that the supply has stabilised before the micro starts.

TR1 is used by the micro to hold the power supply ON whilst it is writing to the filing system. This is to ensure that data is not corrupted when it is writing and the power is turned off.

TR2 allows the micro to turn off the power and switch off the unit. This is normally done when the unit is left on for a long period of time. To preserve the battery, it turns it off.

Memory Map

0x000000	-	0x040000	256K	Internal Flash
0x400000	-	0x480000	512K	External Ram for modules
0x800000				Flash Prom (Single address used)
0xC00000				Display Controller
0xFFDC00 –		0xFFFBFF	8K	Internal Ram – stack.

Keypad interface (069–15)

The 26 keypad switches are arranged in a 5 X 5 matrix and a separate On/Off key. When the keypad is being read by the processor the 5 columns are sequentially driven low by the port lines PE0 – PE4. The state of the 5 rows is read by the port P40 – P44. The diodes in the keypad PCB isolate the outputs from the Port to ensure that a high current will not flow from an output set high to one set low if two keys are pressed simultaneously. The ON/OFF key is connected to the power control circuitry described in the **Power Supply** section.
Resistor RN1 ensures that the keys that are not pressed are read as high.

Serial interface (069-15)

The uC communicates with the PC or the printer via an RS232 serial interface at 38,4 Kbits per sec baud rate, with 8 bits data, 1 stop bit and no parity. U17 converts the RS232 signal to a logic signal of 3.3V. The uC has two inbuilt serial controllers, SCI0 and SCI1. SCI0 is used for synchronous data transfer whilst SCI1 is used in asynchronous mode for RS232.

Real Time Clock (069-15)

U18 is a Xicor X1243 real time clock with 2Kbyte of EEPROM. It operates at 32.768 Khz and is powered by the lithium battery. The device requires a very small amount of power during standby mode and as the unit will never drain the battery out, this should be sufficient to keep the clock going for a long period of time before recharging. The clock is set by the processor during the factory set-up and should not require any further adjustment. The date and time can be changed from the system menu.

The interface to the clock is via a I2C bus. The uC does not have a dedicated I2C bus, so two port lines (P20 – P21) are used under software to emulate the bus.

The EEPROM is used for storing the calibration value and other system data. If the device is ever replaced, the unit will have to be reconfigured and recalibrated.

Temperature Sensor

U19 is a Dallas DS18S20 temperature sensor operating on their one wire bus protocol. It has an accuracy of 0.5 degree centigrade. A port line P23 is used under software to emulate the one wire bus.

The ambient temperature reading is used for adjusting inspiratory flow at ambient temperature to respective flow at body temperature.

Transducer interface (069-16)

The supply to the two series LED's inside the transducer housing is provided through TR9 which is switched on or off by TR3. This is controlled by port pin P26 of the processor and is only turned on during a spirometry manoeuvre to conserve power. However, power is supplied to the transducer through D2 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 two phototransistors is provided by R37 and R38.
The signal from the phototransistor is applied to the pulse timing input of the processor (P16) after being squared up by the action of the Schmitt inverter U13.
The signal from the second phototransistor, after conditioning (U14) is applied to a D type latch, clocked by the first phototransistor, to determine the direction of the turbine. The direction signal is fed to uC via port P17. The rising edge of the signal applied to P16 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 P17. 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.

Display (069-03)

The display is a high resolution custom graphic 240 by 120 dot LCD. It is controlled by an Epson SED1335 display controller (U24), which directly interface to the uC. The display controller timing is generated by a 10 MHz crystal (X4). U23 is a 32K byte RAM to hold the display data.

The LCD display is based on four planes, each requiring different plane voltage. It is biased by 22 V generated by DC-DC controller U9. VR2 varies this voltage which in turn changes the contrast. At dark level, the bias voltage is typically 22.6V and the plane voltages are 20.9V, 19.2V, 3.5V and 1.7V. Of course, they would be slightly different for different contrast level. The plane voltages are generated by resistor ratio dividers (R23, R24, R53, R26, R27) and buffered by quad Op-amp U25.
J8 is a connector to the display.

Power Supply (069-14)

The power to the system is either supplied by the 7.2V ni-cad battery or from an external 9V DC regulated power supply. If the external supply is connected, then TR4 is switched off and the battery is not used. R30 ensures that the battery is trickle charged at all times.

The on/off key is conditioned via U10 and applied to set/reset D type flip flop (U11). On every key press, the flip flop toggles between the on and off state. In the On state, TR6 is switched on, switching on TR5. The on state can be held by MC_ON- line from the uC whilst it is saving data in the Flash PROM. The uC can also switch the power off by means of the MC_OFF- line which resets U11.

U8 is a DC-DC converter with an input range of 0.9V to 10V and an output of 3.3 volts to power the unit. Since the range is up to 10V only, care should be taken not to use any other external power supply, as most of them are unregulated and could output 12V for a 9V unregulated supply.

U7 is another DC-DC converter with an output of 9V. This higher supply is used for powering the sensor LEDs.

R36 and R7 divide the unregulated voltage to a third and are applied to the A/D converter of the uC. The uC continuously examines the reading and gives a battery low or battery dead warning message. From the reading the uC can also deduce that the external supply is connected, so it can turn itself off if the unit is left on for a long time.

Inductors L1 and L2 are placed for EMC filtering and D5 protects the unit from reverse polarity power supply

Printer Driver (Drawing 069-04, 069-05, 069-06)

The printer driver uses a single chip micro-controller (U12) with on board program memory and RAM to receive serial data from the microprocessor (U2) 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 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 (U12). The signals pass through sixteen current transistors (TR10 to TR25). Timing for Port A and B is derived from an adjustable oscillator comprising of U21 and associated components. Adjusting VR1 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, J7. The end switch is detected by PD5 on the micro-controller.

Designation	Part No.	Description.
U1	MAX824TEXK-T	Maxim power monitor, SOT23-5 package
U2	HD64F2318VTE25	Hitachi H8S/2318 microcontroller, TQFP100 package
U3	BU4S11	Rohm individual CMOS gate, SOT23-5 package
U4	K6T4008V1C-BB70	Samsung 512k X 8 bit CMOS static RAM, SOL32/525
U5	K9F6408U0A-TCB0	Samsung 8M X 8 bit FLASH memory, TSOP44/40
U6	74LCX32	Quad 2-input OR gate
U7	LT1613CS5	Linear Technology DC/DC convertor, SOT23-5 package
U8	LT1613CS5	Linear Technology DC/DC convertor, SOT23-5 package
U9	LT1613CS5	Linear Technology DC/DC convertor, SOT23-5 package
U10	4093	CMOS Quad NAND Schmitt input gate, SO-14 package
U11	4013	CMOS Dual D Type flip flop, SO-14 package
U12	MC68HC705C9ACFN	Motorola OTP microprocessor
U13	BU4S584	Rohm individual CMOS Schmitt invertor, SOT23-5
U14	BU4S584	Rohm individual CMOS Schmitt invertor, SOT23-5
U15	MAX4544EUT-T	Maxim SPDT analogue switch, SOT23-6 package
U16	MAX4544EUT-T	Maxim SPDT analogue switch, SOT23-6 package
U17	MAX3221CAE	Maxim RS232 transceiver, SSOP16 package
U18	X1243S8	Xicor clock calander with 256 X 8 bit RAM, SO-8 package
U19	DS18S20	Dallas semiconductor digital thermometer, TO-92B
U20	4013	CMOS Dual D Type flip flop, SO-14 package
U21	4069UB	Surface mount unbuffered hex invertor
U22	LT1084CT	LDO adj 5 amp regulator or National LM1084IT-ADJ
U23	GM76C256CLLFW-55-T/R	Gold Star 32K X 8 bit CMOS static RAM, 28 pin SOP
U24	SED1335FOB	Display driver
U25	LM324	Quad surface mount op amp
U26	LT1613CS5	Linear Technology DC/DC convertor, SOT23-5 package
R1		100K resistor 1%, 0805 package
R2		10K resistor 1%, 0805 package
R3		10K resistor 1%, 0805 package
R4		100K resistor 1%, 0805 package
R5		100K resistor 1%, 0805 package
R6		100K resistor 1%, 0805 package
R7		100K resistor 1%, 0805 package
R8		100K resistor 1%, 0805 package
R9		100K resistor 1%, 0805 package
R10		100K resistor 1%, 0805 package
R11		100K resistor 1%, 0805 package
R12		100K resistor 1%, 0805 package
R13		4.7K resistor 1%, 0805 package
R14		10K resistor 1%, 0805 package
R15		10K resistor 1%, 0805 package
R16		100K resistor 1%, 0805 package
R17		100K resistor 1%, 0805 package
R18		10 ohm resistor 1%, 0805 package
R19		1K resistor 1%, 0805 package
R20		10K resistor 1%, 0805 package
R21		10K resistor 1%, 0805 package
R22		10K resistor 1%, 0805 package
R23		10K resistor 1%, 0805 package
R24		10K resistor 1%, 0805 package

Designation	Part No.	Description.
R25		10K resistor 1%, 0805 package
R26		10K resistor 1%, 0805 package
R27		10K resistor 1%, 0805 package
R28		13K resistor 1%, 0805 package
R29		82K resistor 1%, 0805 package
R30	337-717 (F)	68 ohm 1 watt axial resistor
R31		39K resistor 1%, 0805 package
R32		68K resistor 1%, 0805 package
R33		100 ohm resistor 1%, 0805 package
R34		10K resistor 1%, 0805 package
R35		1K resistor 1%, 0805 package
R36		200K resistor 1%, 0805 package
R37		4.7K resistor 1%, 0805 package
R38		4.7K resistor 1%, 0805 package
R39		10 Meg resistor 1%, 0805 package
R40		220K resistor 1%, 0805 package
R41		100K resistor 1%, 0805 package
R42		1K resistor 1%, 0805 package
R43		1K resistor 1%, 0805 package
R44		1K resistor 1%, 0805 package
R45		10 Meg resistor 1%, 0805 package
R46		22K resistor 1%, 0805 package
R47		22K resistor 1%, 0805 package
R48		150K resistor 1%, 0805 package
R49		150K resistor 1%, 0805 package
R50		2.2K resistor 1%, 0805 package
R51		120 ohm resistor 1%, 0805 package
R52		390 ohm resistor 1%, 0805 package
R53		91K resistor 1%, 0805 package
RN1	107-048 (F)	6 pin, 5 commoned 100K resistor, SIL network
RN2	219-186 (F)	5 pin, 4 commoned 10K resistor, SIL network
RN3	776-701(F)	1k 4 individual resistor network, 1206 package
RN4	776-701(F)	1k 4 individual resistor network, 1206 package
RN5	776-701(F)	1k 4 individual resistor network, 1206 package
RN6	776-701(F)	1k 4 individual resistor network, 1206 package
VR1	499-663(F)	20K single turn surface mount preset
VR2	T18 S/I S/B S/T 20KA	Piher 20K linear potentiometer
C1		100nF Philips or AVX ceramic, 0805 package
C2		100nF Philips or AVX ceramic, 0805 package
C3		100nF Philips or AVX ceramic, 0805 package
C4		100nF Philips or AVX ceramic, 0805 package
C5		100nF Philips or AVX ceramic, 0805 package
C6		100nF Philips or AVX ceramic, 0805 package
C7		100nF Philips or AVX ceramic, 0805 package
C8		100nF Philips or AVX ceramic, 0805 package
C9		100nF Philips or AVX ceramic, 0805 package
C10		100nF Philips or AVX ceramic, 0805 package
C11		33pF Philips or AVX ceramic, 0805 package
C12		33pF Philips or AVX ceramic, 0805 package
C13		33pF Philips or AVX ceramic, 0805 package
C14		33pF Philips or AVX ceramic, 0805 package

Designation	Part No.	Description.
C15	197-324 (F)	47uF/16v Surface mount Tantalum
C16	197-324 (F)	47uF/16v Surface mount Tantalum
C17		100nF Philips or AVX ceramic, 0805 package
C18		100nF Philips or AVX ceramic, 0805 package
C19		100nF Philips or AVX ceramic, 0805 package
C20		100nF Philips or AVX ceramic, 0805 package
C21		100nF Philips or AVX ceramic, 0805 package
C22		100nF Philips or AVX ceramic, 0805 package
C23		100nF Philips or AVX ceramic, 0805 package
C24		100nF Philips or AVX ceramic, 0805 package
C25		100nF Philips or AVX ceramic, 0805 package
C26		100nF Philips or AVX ceramic, 0805 package
C27		100nF Philips or AVX ceramic, 0805 package
C28		100nF Philips or AVX ceramic, 0805 package
C29		100nF Philips or AVX ceramic, 0805 package
C30		100nF Philips or AVX ceramic, 0805 package
C31		100nF Philips or AVX ceramic, 0805 package
C32		100nF Philips or AVX ceramic, 0805 package
C33		100nF Philips or AVX ceramic, 0805 package
C34		100nF Philips or AVX ceramic, 0805 package
C35		100nF Philips or AVX ceramic, 0805 package
C36		100nF Philips or AVX ceramic, 0805 package
C37		100nF Philips or AVX ceramic, 0805 package
C38		100nF Philips or AVX ceramic, 0805 package
C39	301-8544 (F)	33uF/16v Surface mount Tantalum
C40	301-8544 (F)	33uF/16v Surface mount Tantalum
C41	197-312 (F)	33uF/16v Surface mount Tantalum
C42	197-312 (F)	33uF/16v Surface mount Tantalum
C43	301-7000 (F)	100uF/16v
C44		1uF Philips or AVX ceramic, X7R dielectric, 0805 package
C45		1nF Philips or AVX ceramic, 0805 package
C46		1nF Philips or AVX ceramic, 0805 package
C47		33pF Philips or AVX ceramic, 0805 package
C48		33pF Philips or AVX ceramic, 0805 package
C49	197-312 (F)	33uF/16v Surface mount Tantalum
C50	197-312 (F)	33uF/16v Surface mount Tantalum
C51		1uF Philips or AVX ceramic, X7R dielectric, 0805 package
C52		390pF Philips or AVX ceramic, 0805 package
C53	556-180 (F)	47uF/16v Surface mount Electrolytic
C54	556-180 (F)	47uF/16v Surface mount Electrolytic
C55		10pF Philips or AVX ceramic, 0805 package
C56		10pF Philips or AVX ceramic, 0805 package
C57	301-8593 (F)	47uF/25v Surface mount Tantalum
C58		1uF Philips or AVX ceramic, X7R dielectric, 0805 package
C59		1uF Philips or AVX ceramic, X7R dielectric, 0805 package
C60		1uF Philips or AVX ceramic, X7R dielectric, 0805 package
C61		1uF Philips or AVX ceramic, X7R dielectric, 0805 package
C62		1uF Philips or AVX ceramic, X7R dielectric, 0805 package
C63		100nF Philips or AVX ceramic, 0805 package
TR1	DTC114EK	Rohm NPN digital transistor, SOT-23 package
TR2	DTC114EK	Rohm NPN digital transistor, SOT-23 package

Designation	Part No.	Description.
TR3	DTC114EK	Rohm NPN digital transistor, SOT-23 package
TR4	ZXM62P02E6	P channel MOSFET SOT23-6 package
TR5	ZXM62P02E6	P channel MOSFET SOT23-6 package
TR6	FMMT491A	Zetex NPN Transistor SOT-23 package
TR7	FMMT491A	Zetex NPN Transistor SOT-23 package
TR8	FMMT491A	Zetex NPN Transistor SOT-23 package
TR9	DTB113EK	Rohm PNP digital transistor, SOT-23 package
TR10	FMMT491A	Zetex NPN Transistor SOT-23 package
TR11	FMMT491A	Zetex NPN Transistor SOT-23 package
TR12	FMMT491A	Zetex NPN Transistor SOT-23 package
TR13	FMMT491A	Zetex NPN Transistor SOT-23 package
TR14	FMMT491A	Zetex NPN Transistor SOT-23 package
TR15	FMMT491A	Zetex NPN Transistor SOT-23 package
TR16	FMMT491A	Zetex NPN Transistor SOT-23 package
TR17	FMMT491A	Zetex NPN Transistor SOT-23 package
TR18	FMMT491A	Zetex NPN Transistor SOT-23 package
TR19	FMMT491A	Zetex NPN Transistor SOT-23 package
TR20	FMMT491A	Zetex NPN Transistor SOT-23 package
TR21	FMMT491A	Zetex NPN Transistor SOT-23 package
TR22	FMMT491A	Zetex NPN Transistor SOT-23 package
TR23	FMMT491A	Zetex NPN Transistor SOT-23 package
TR24	FMMT491A	Zetex NPN Transistor SOT-23 package
TR25	FMMT491A	Zetex NPN Transistor SOT-23 package
D1	ZHCS1000	Zetex Schottky diode, SOT-23 package
D2	ZHCS1000	Zetex Schottky diode, SOT-23 package
D3	ZHCS1000	Zetex Schottky diode, SOT-23 package
D4	ZHCS1000	Zetex Schottky diode, SOT-23 package
D5	ZHCS1000	Zetex Schottky diode, SOT-23 package
D6	BAS19	General purpose diode, SOT-23 package
D7	UMN1NTR	Quad commoned diode, IMN10 package
D8	UMN1NTR	Quad commoned diode, IMN10 package
D9	UMN1NTR	Quad commoned diode, IMN10 package
D10	UMN1NTR	Quad commoned diode, IMN10 package
D11	ZHCS1000	Zetex Schottky diode, SOT-23 package
D12	BAS21	General purpose diode, SOT-23 package
D13	BAS21	General purpose diode, SOT-23 package
D14	DE5SC4M	Dual commoned diode
D15	U1JC44	1A Toshiba diode
D16	ZHCS1000	Zetex Schottky diode, SOT-23 package
F1	MICROSMD035-2	Tyco 700mA Polyswitch
L1	NLFC453232-3R3M	3.3uH inductor, 1210 package
L2	NLFC453232-3R3M	3.3uH inductor, 1210 package
L3	353-1340 (F)	22uH inductor, 1210 package
L4	353-1340 (F)	22uH inductor, 1210 package
L5	353-1340 (F)	22uH inductor, 1210 package
L6	353-1340 (F)	22uH inductor, 1210 package
L7	353-1340 (F)	22uH inductor, 1210 package
DISPLAY	LTA75R227J	Nan Ya 240 X 160 graphic display
PRINTER	STP411B-320	Seiko thermal printer mechanism
J1		3 way 0.1" pitch pin header
J2		2 way 0.1" pitch pin header
J3		2.5mm DC power socket from G.English
J4	95001-2661	Molex 6 way data socket

Drawing No. 069-00		Date 19/09/02
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Designation	Part No.	Description.
J5	14FMN-BMTTN-TF	14 way 1mm pitch cable connector from JST
J6	MDS4	4 way mini DIN socket
J7		25 way connection to printer mechanism
J8	18FMN-BMTTN-TF	18 way 1mm pitch cable connector from JST
BAT1		3 way PCB socket from JST
SPKR	PKM35-4A0	Murata piezo ceramic sounder
X1		20MHz crystal, HC49/4H package
X2	571-672 (F)	32.768 KHz crystal, WATCH package
X3	295-267 (F)	4.0MHz
X4	485-081 (F)	10MHz crystal
SW1	773-209 (F)	2 pole momentary push switch

DRIVER2
DRIVER2.SCH

DRIVER1
DRIVER1.SCH

IN9
IN10
IN11
IN12
IN13
IN14
IN15
IN16
OUT9
OUT10
OUT11
OUT12
OUT13
OUT14
OUT15
OUT16

IN1
IN2
IN3
IN4
IN5
IN6
IN7
IN8
OUT1
OUT2
OUT3
OUT4
OUT5
OUT6
OUT7
OUT8

IN9
IN10
IN11
IN12
IN13
IN14
IN15
IN16
OUT9
OUT10
OUT11
OUT12
OUT13
OUT14
OUT15
OUT16

IN1
IN2
IN3
IN4
IN5
IN6
IN7
IN8
OUT1
OUT2
OUT3
OUT4
OUT5
OUT6
OUT7
OUT8

PRINTER
PRINTER.sch

PRNBUSY
RESET-
ONLINE
PRINTDATA
PRINTACK

DISPLAY
display.sch

D[0..7]
RD-
WR-
A0
DISP_CS-
RESET-

Power Supply
power.sch

ONOFF_KEY
MC_ON-
MC_OFF-
RTC_ON-
BAT_MON

D[0..7]

micro
MICRO.sch

SEN1
SEN2
SEN_EN

SEN-
SIN
SCLK
SOUT
SOUT_EN-
SENDIR

PRNBUSY
RESET-
ONLINE

D[0..7]
RD-
WR-
A0
DISP_CS-

RESET-

MC_ON-

MC_OFF-

BAT_MON

RX
TX
MODE
TEMP_IO
RTC_DATA
RTC_CLK

KEYOUT[0..4]

KEYIN[0..4]

PRINTACK
PRINTDATA

KEYOUT[0..4]
KEYIN[0..4]

Sensors
sensor.sch

SEN1
SEN2
SEN_EN

RS232
serial.sch

SEN-
SIN
SCLK
SOUT
SOUT_EN-
SENDIR

RX
TX
MODE
TEMP_IO
RTC_DATA
RTC_CLK
RTC_ON-
KEYOUT[0..4]
KEYIN[0..4]
ONOFF_KEY

14

MicroLab - Circuit diagram, display section

Title

Size A3
Number 069-03
Revision 1.0

Date 6-Nov-2002
File H:\TEMP\069-03.sch
Sheet of
Drawn By: DECOCKS

16

J7 CON25

OUT1 OUT2 OUT3 OUT4 OUT5 OUT6 OUT7 OUT8

OUT9 OUT10 OUT11 OUT12 OUT13 OUT14 OUT15

IN1 IN2 IN3 IN4 IN5 IN6

IN7 IN8 IN9 IN10 IN11 IN12 IN13

R42 1K
VP
R22 10K
VCC
C8 0.1uf

U12 MC68HC05C9ACPN(44)
OSC1 OSC2 RST IRQ TCAP TCMP
PA7 PA6 PA5 PA4 PA3 PA2 PA1 PA0
PB0 PB1 PB2 PB3 PB4 PB5 PB6 PB7
PC0 PC1 PC2 PC3 PC4 PC5 PC6 PC7
PD0/MDI PD1/TDO PD2/MISO PD3/MOSI PD4/SCK PD5/SS
PD7
NC NC NC NC

PRNBUSY
VCC
R43 1K

C14 33PF
X3 4.0 MHz
R45 10MEG
C13 33PF

R16 100K
VCC

RESET
PRINTDATA
PRINTACK
ONLINE

SW1 P.F.

U21E 4069UB
U21C 4069UB
U21D 4069UB
U21B 4069UB
U21A 4069UB
U21F 4069UB

C52 390PF
VCC
R17 100K
R46 22K
R50 2K2
TR7 PMMT491
VR1 20K 3374X
R48 150K
R47 22K
D6 BAS19

C21 0.1uf C22 0.1uf C23 0.1uf C24 0.1uf C25 0.1uf
VCC

U22 LT1084CT
VIN GND VOUT
120 OHM
390 OHM
C53 47uF
C54 47uF
VPRINT
VP
TR8 PMMT491A
RN2 10K

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MicroLab - Circuit diagram, power supply

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Temperature Sensor

U19
VDD
DQ
GND
DS1RS20

VCC
C20
0.1uF

VCC
R13
4K7

TEMP IO

RX
TX

VCC
R21
10K

C19
0.1uF

C36
0.1UF

VCC
C36
0.1UF

VBACK

C38
0.1UF

VCC
C37
0.1UF

C35
0.1UF
C34
1UF

VCC

KEYPAD4M3

ESC   DEL   ENTER
0   -   ↓   F4
1   4   7   ↑   F3
2   5   8   →   F2
3   6   9   ←   F1

13
11
9
7
5
14
12
10
8
6
4
3
2
1

OFF
ON
LS

9V

KEYOUT0
KEYOUT1
KEYOUT2
KEYOUT3
KEYOUT4

KEYIN0
KEYIN1
KEYIN2
KEYIN3
KEYIN4

U17
EN FOFF
C1+
V+
C1-
C2+
C2-
V-
RIN
16
15
14
13
12
11
10
9
1
2
3
4
5
6
7
8
T0
FON
TIN
INT
RO
VCC
MAX221CAE

C33
0.1UF
VCC

C32
0.1UF
VCC

U18
XD2458I
SDA VB
TX
1X
SCL VDD
INT VSS

X2
32.768KHz

R39
10M
R40
220K

C48
33PF
C47
33PF

RTC DATA
RTC CLK

VCC
R14
10K

J6
MINI_DIN_4
VCC

RN1
100K-8N
VCC
7
6
5
4
3
2
1

KEYIN[0..4]
KEYOUT[0..4]
ON/OFF_KEY
MODE

RTC DATA
RTC CLK

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To Internal Printer.

PRINTACK

PRINTDATA

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