



SERVICE MANUAL SPIROBANK & SPIROBANK G



SPIROBANK HARDWARE DESCRIPTION

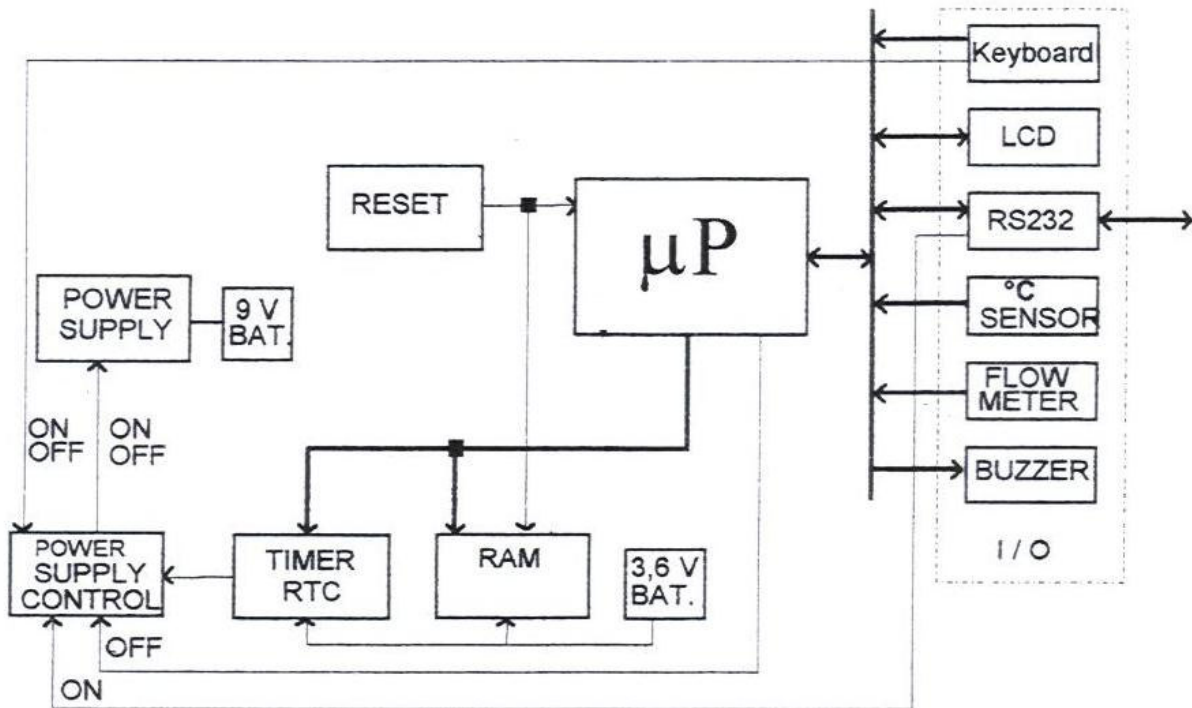


Fig.1
SYSTEM BLOCK DIAGRAM

The hardware system is made up of 6 main blocks:

1. Microprocessor
2. I/O peripherals
3. RAM
4. RTC
5. Power supply
6. Reset circuit

These main blocks are illustrated in fig.1.

The narrow lines serve to show the distinction between the power up (ON) , power down (OFF) and reset circuits.

Now we can look at the main characteristics within each block.

Microprocessor

Motorola 68HC11F1FN, at the “heart” of the system (IC3), and all of the other system components are controlled from this uP. From within the microprocessor:

- a) the 8 –bit DATA BUS controls the LCD and also controls data exchange to and from the external static RAM (IC9).

- b) allocates a 16 bit ADDRESS BUS to the 128kb *8bit RAM
 - c) the I/O address space is automatically controlled by means of 2 of the four built-in CHIP-SELECT outputs (CSIO1 for the LCD, CSPROG for the external RAM)
 - d) another CHIP-SELECT line (CSGEN) controls the access to the two –page RAM,64kb each page.
 - e) Has 8 A/D inputs, two of which (TEMP and HVZB) are used for reading the temperature sensor and the measurement of the battery level of the 9V main battery.
-

I/O Peripherals

- a) Keyboard with 5 keys :

Description of the 7 pins of the keyboard connector (CON2):

- 1) direct power supply (circa 6V,VZB) unregulated
- 2) manual power –down key (OFF)
- 3) regulated power supply 5V (VCC)
- 4) key 1
- 5) key 2
- 6) key 3
- 7) key CR /Return/Enter) and manual power on (ON)

The 1,2,3 and CR keys are connected to the 4 input ports of the uP for reading the pressed key when the system is switched on.

When instead the machine is switched off the only active key is the CR which allows the unit to be switched on.

The manual power off is activated by the OFF key.

- b) LCD

2) Line /16 character per line display.

The LCD is connected to the uP via the 8 bit DATA BUS and 4 lines of control.

- c) RS232

Bidirectional serial port asincronous controlled by the uP via its serial port.

Towards the PC the port has 5 lines (CON3) configured as follows:

- 1 VB (9V circa)-direct power on unregulated
- 2 RX
- 3 TX inverted
- 4 TX
- 5 RTS

d) Temperature sensor

Transducer of temperature/voltage (IC7) NATIONAL LM 35. The output signal, amplified by way of an operational amplifier (IC6) is connected to one of the A/D channels of the uP (line TEMP , 100mV=1 degree Centigrade).

e) Flow meter

Sensor for the measurement of the flow and volume air.

The sensor is comprised of:

Mechanical parts

- (a) A tube in polycarbonate –IR (transparent to infrared light)
- (b) A pair of swirl (deflectors) positioned at the exit of the tube , in order to create a vortice of the moving air within the axis of the senmsors.
- (c) A moving part (rotor), the velocity of rotation of which is proportional to the flow of air passing through the tube .

Electrical parts

- (a) Two pairs of infrared transmitters/receivers positioned as shown infig.2.
- (b) A signal conditioning circuit (C%,C6,R12,D5,D6,IC8) to rectify the output signal from the two infrared light receivers.

The rotation of the rotor causes the interruption of the infrared rays, thus creating a signal which has a frequency directly proportional to the flow.

The measurement of the flow of air which passes through the tube is therefore proportional to the number of interruptions of the infrared rays.

The phase difference $\Delta\phi$ (positive or negative) between the signals from each of the two infrared receivers (IR1 and IR2) depends upon the direction of rotation of the moving rotor and therefore supply the information on the direction (expiration or inspiration) of the air flow.

In detail, $\Delta\phi > 0$ for expiratory flow, $\Delta\phi < 0$ for inspiratory flow.

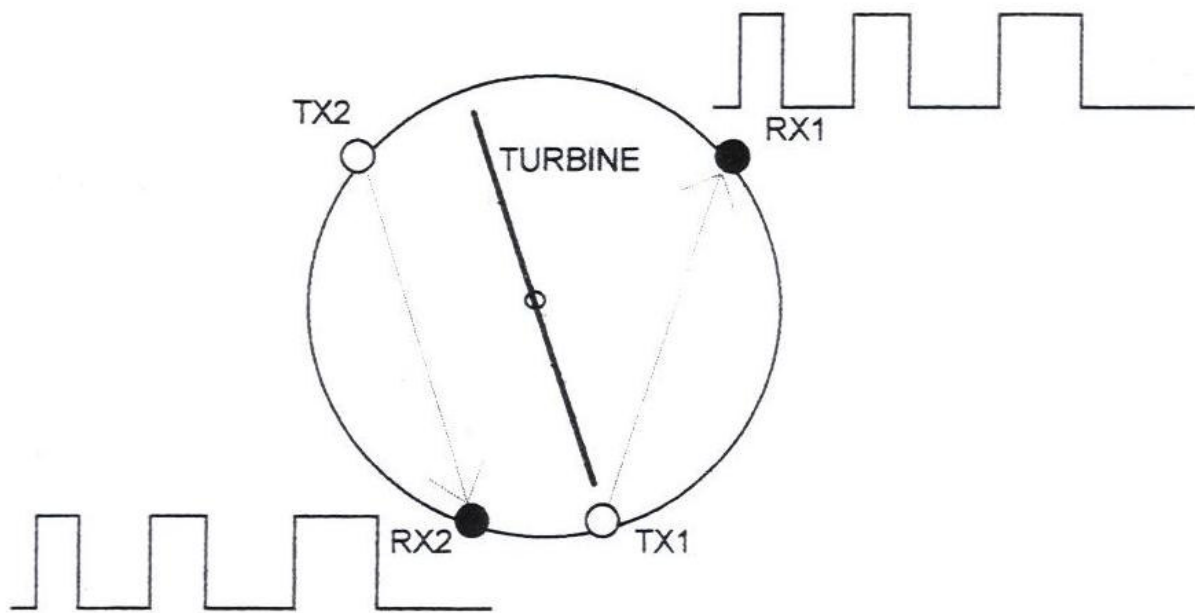


Fig.2
Diagram of the turbine operation

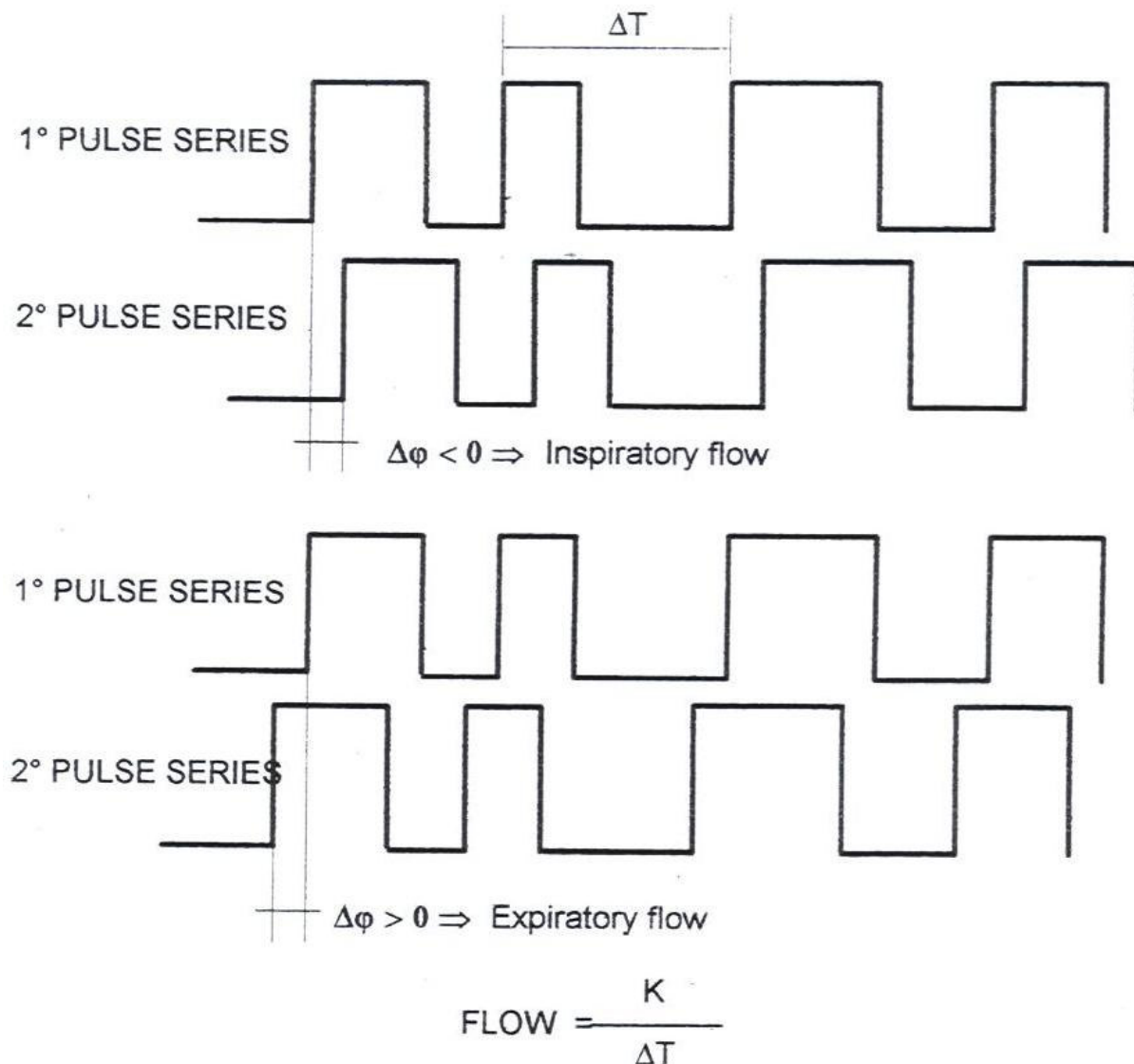


Fig.3

Output of the two infrared receivers IR1, IR2 for inspired and expired air flows.

The two wave trains are squared by a Schmitt trigger (IC8) and then sent to two input ports of the uP. The uP has the possibility to switch the turbine on or off (by switching on or off the infrared transmitters) by way of a second output port.

f) buzzer

Piezoelectric buzzer with internal oscillator, with resonance frequency of 4KHz. The activation of the buzzer is controlled directly via two output ports of the uP.

RAM

Static RAM 128k* 8 bit (IC9). The power down phase is controlled by the RESET signal and data retention (backup) is powered by the 3.6V lithium battery (IT1).

The RAM is configured in two pages each of 64 Kbyte. The access to the pages is controlled directly from an output port of the uP (line CSGEN).

Page 1 contains the measured spirometric data (database) and the application software.

Page 2 contains a reserve copy of the software which is utilised only in the case of a checksum error in page 1. The checksum is controlled every time that the system is switched on.

In the case of a malfunction a message on the display informs the user that the data contained in the RAM memory have been cancelled.

Timer

Real Time Clock connected to the uP via an I/O line, and via which bidirectional serial communication is also managed. Contains the current date and time.

Access to the timer is regulated by a security code of 64 bit which therefore avoids unauthorised changes to the contents of the timer and of its internal memory, which also contains all of the configuration data of the system software.

In case of a malfunction the default configuration is reinstalled and a message informs the user that the data in the timer have been cancelled.

By use of an output signal(IRQ), the machine can be switched on at a preset time. The data retention (backup) is assured by the 3.6V lithium battery (IT1).

Power supply

The main power for the system is supplied by a 9V battery (alkaline or similar). The back up power is supplied by an internal lithium battery of 3.6V, attached directly to the PCB.

The maximum power consumption of the machine (when the flow meter is also in operation) is 25mA. The consumption when the machine is in operation but without the flow meter switched on is 12mA. Each time that the machine is in input phase the machine is put into a wait state and the consumption is then 3mA.

The consumption of the lithium battery active when the system is switched off (data retention mode), at an ambient temperature of 25 degrees is approximately 1uA.

The power supply is made of two integrated circuits:

- (a) A JK flip-flop (IC2), to carry out the function of power supply control.
- (b) Three functional blocks are connected to this circuit, which are able to power up and/or power down the system.
 - 1) Manual power on and power off: by keyboard
 - 2) Automatic power on: by RS232 or by RTC timer
 - 3) Automatic power off: by uP

(c) A linear 5V regulator (IC5), with control input for:

- 1) shutdown to manage the ON/OFF of the Vcc voltage
- 2) Low battery to compare the voltage of the backup battery (lithium) with the voltage value preset for low battery (set at 2,8V).

When the system is switched off (OFF) the regulator is put into shutdown mode, and the total power consumption from the 9V battery is reduced to 1 uA.

Reset

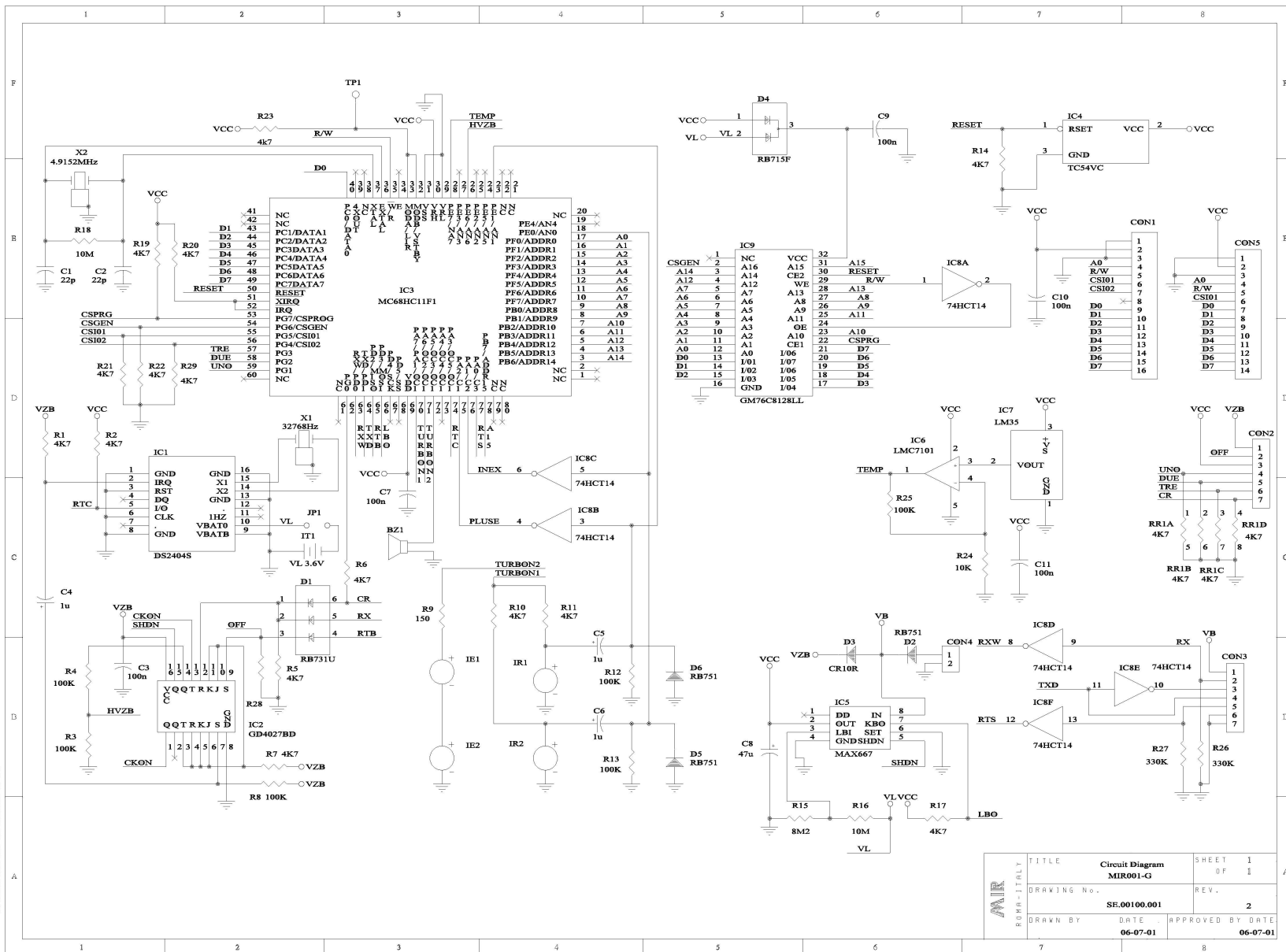
The reset signal is generated by a voltage sensing circuit (IC4).

The reset signal is activated when the voltage at the input is $< 4.7V$.

The reset is applied to the uP and to the RAM where it takes the role of POWER DOWN, for data retention (BACKUP).

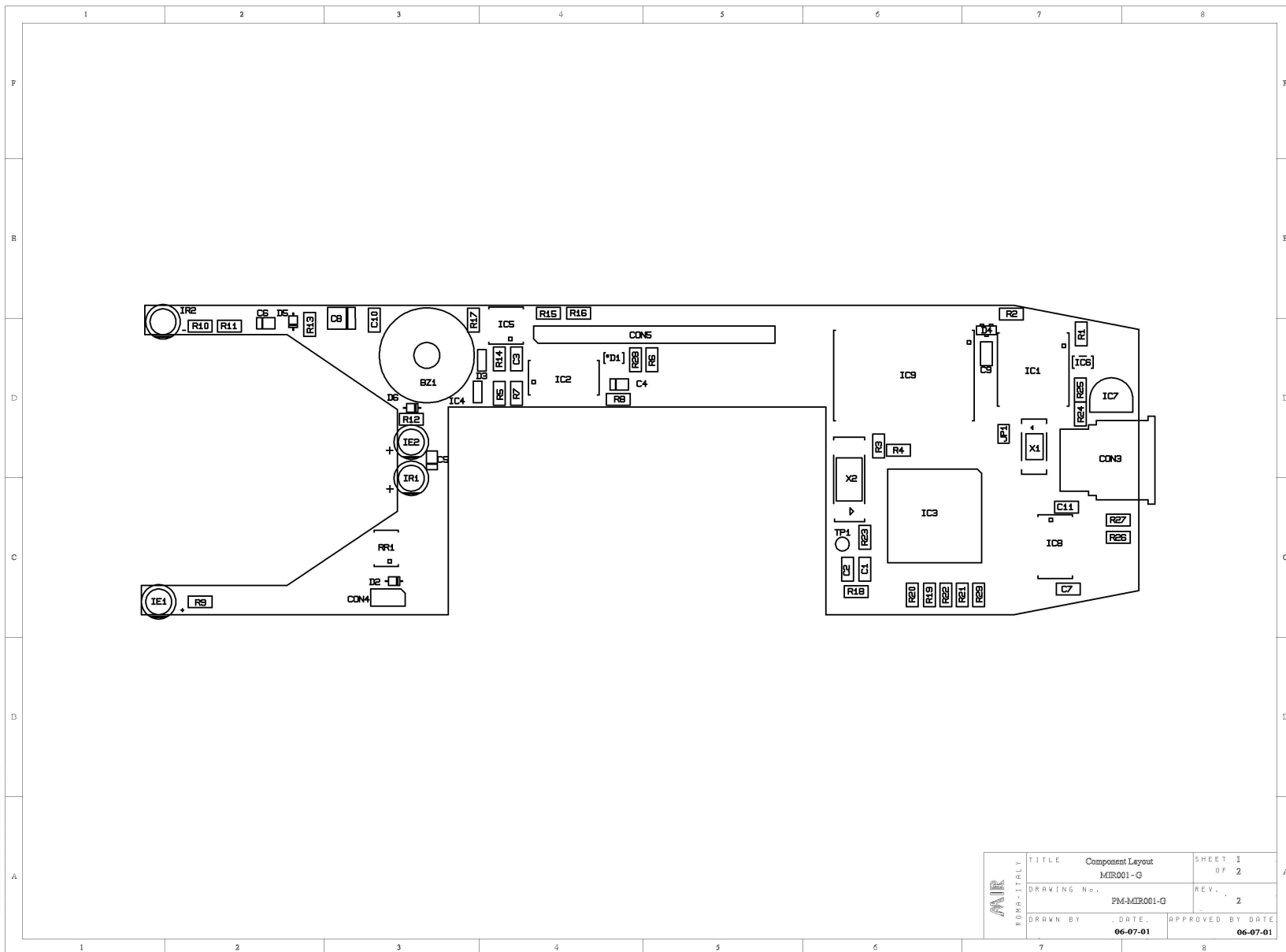
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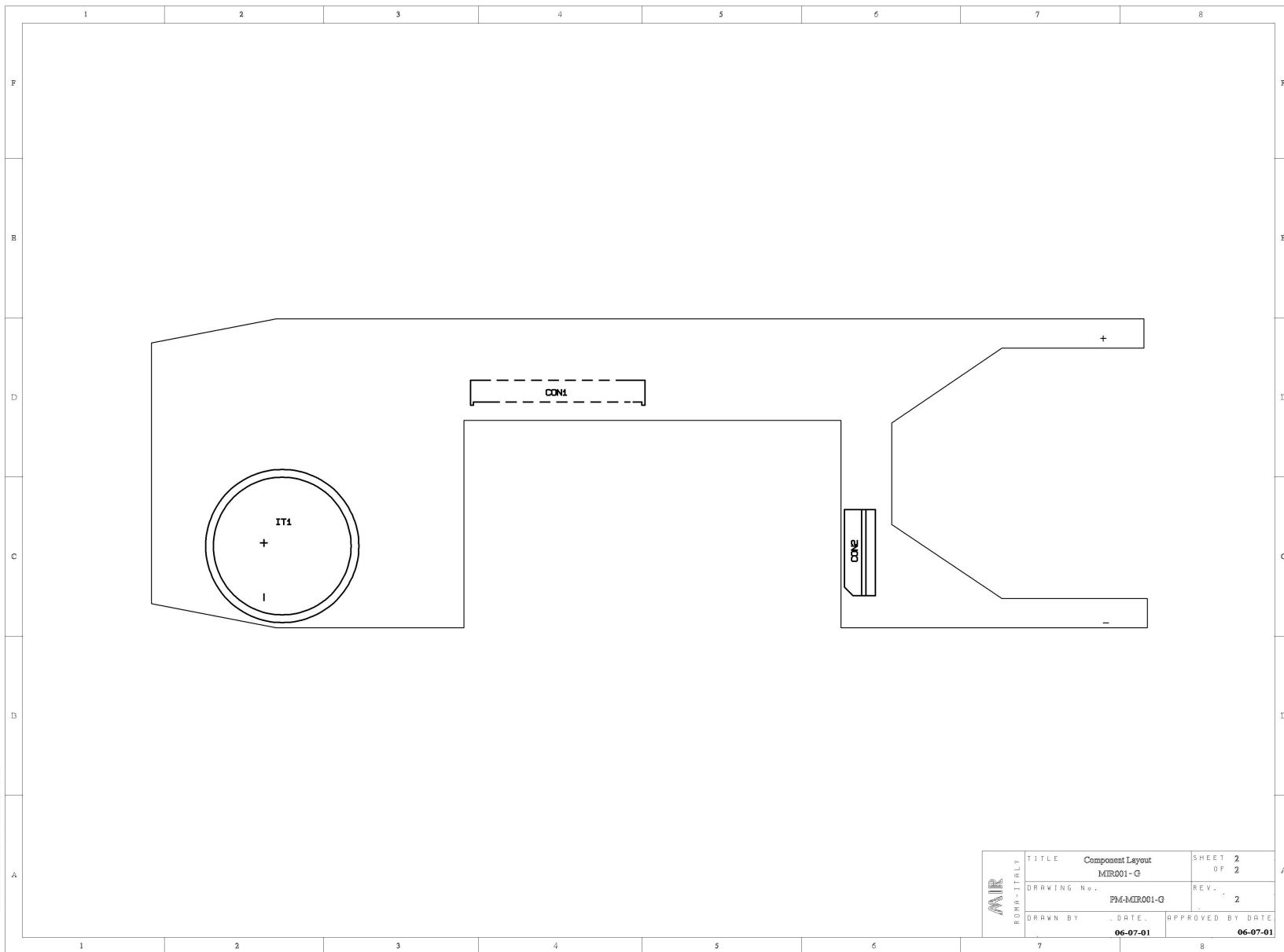
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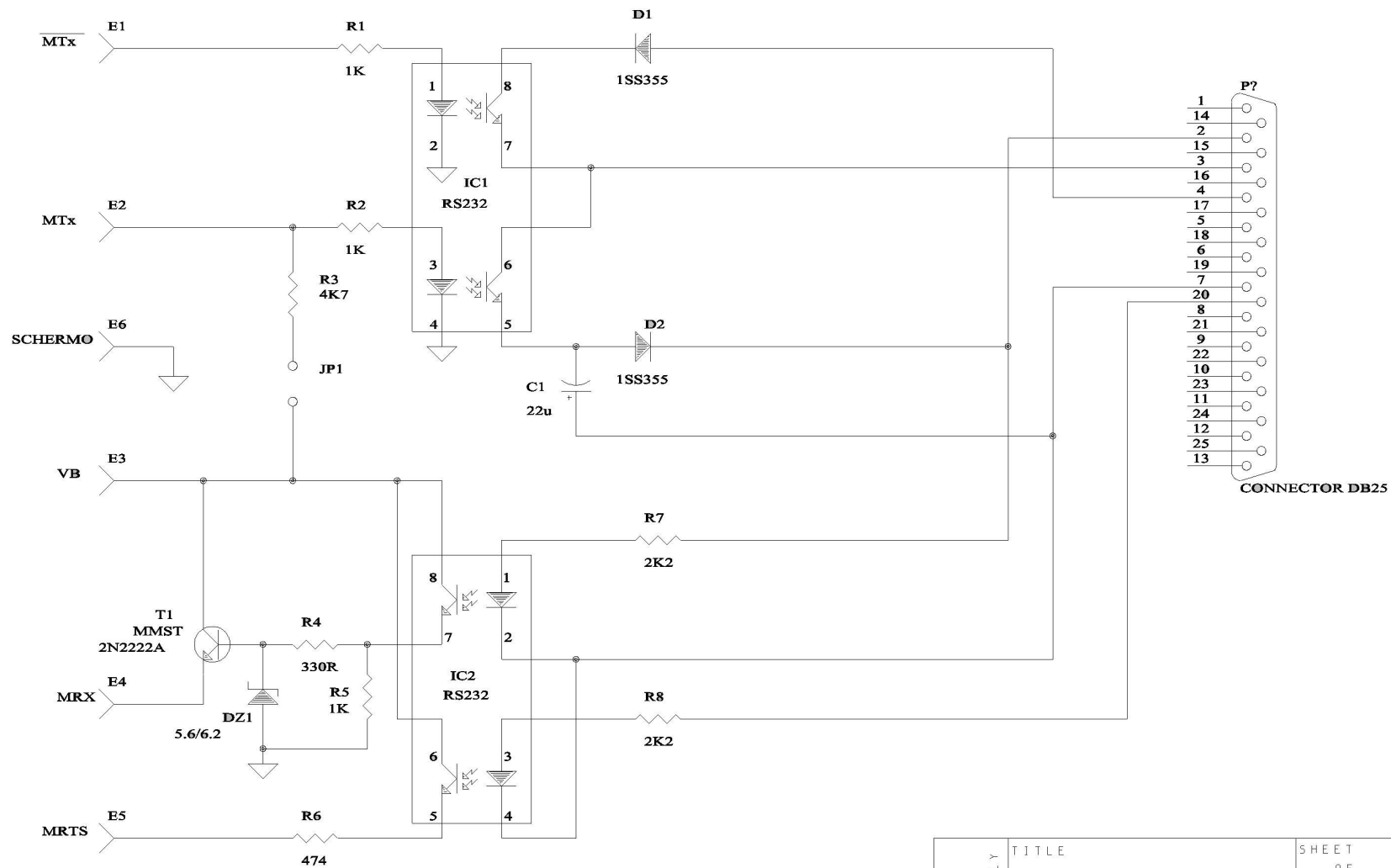


Item	Quantity	Reference	Part	Cod. Art.
1	1	BZ1	BUZZER	560020
2	1	CON1	CON16	130004
3	2	CON3,CON2	CON7	113352-123700
4	1	CON4	CON2	960038
5	1	CON5	CON14	120324
6	2	C1,C2	22p	831708
7	5	C3,C7,C9,C10,C11	100n	831746
8	3	C4,C5,C6	1u	810068
9	1	C8	47u	810036
10	1	D1	RB731U	600050
11	3	D2,D5,D6	RB751	602635
12	1	D3	CR10R	253104
13	1	D4	RB715F	600060
14	1	IC1	DS2404S	644693
15	1	IC2	GD4027BD	640313
16	1	IC3	MC68HC11F1	648171_PU
17	1	IC4	TC54VC	640290
18	1	IC5	MAX667	644930
19	1	IC6	LMC7101	649331
20	1	IC7	LM35	641527
21	1	IC8	74HCT14	648018
22	1	IC9	GM76C8128LL	646452
23	4	IR1,IE1,IR2,IE2	LED_1	631314-630430
24	1	IT1	VL 3.6V	970232
25	1	JP1	JUMPER	
26	17	RR1,R1,R2,R5,R6,R7,R10, R11,R14,R17,R19,R20,R21, R22,R23,R28,R29	4K7	712676

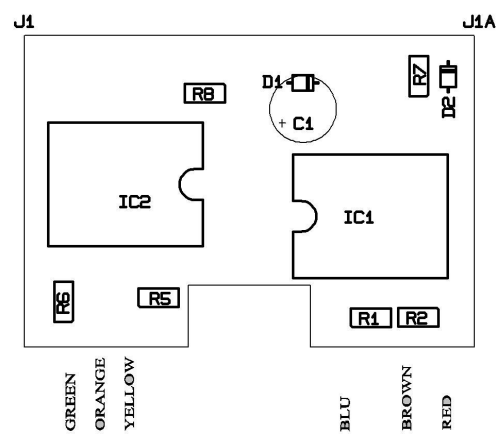
SE.0001.001
Bill Of Materials

Revised: May 27, 2001
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Item	Quantity	Reference	Part	Cod. Art.
27	6	R3,R4,R8,R12,R13,R25	100K	712708
28	1	R9	150	712638
29	1	R15	8M2	712782
30	2	R16,R18	10M	712784
31	1	R24	10K	712684
32	2	R27,R26	510K	712725
33	1	TP1	TP	
34	1	X1	32768Hz	680500
35	1	X2	4.9152MHz	680510
36	1	tab1	TABELLA	
37	1	tab2	MIR	



MIR ROMA-ITALY	TITLE	SHEET OF 1
	DRAWING No. SE.00200.001	REV. 2
	DRAWN BY	APPROVED BY
	DATE	DATE



AIR ROMA-ITALY	TITLE	MIR002/TEL	SHEET	1
		COMPONENT LAYOUT	OF	1
	DRAWING No.	PM-MIR002/TEL	REV.	0
	DRAWN BY	DATE	APPROVED BY	DATE
		21-05-96		21-05-96