DESIGN REPORT

BATCH WEIGHING MACHINE

Prepared in partial fulfillment of the requirements for the course -
Microprocessors and Interfacing (CS/EEE/INSTR F241)

Submitted to Prof. K. R. ANUPAMA,
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING.

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PROBLEM STATEMENT

A microprocessor system is to be designed as a batch weighing machine.
The system is interfaced to three load cells by means of an 8 bit A/D converter.
The conditioned output of the load cells is given by the equation:

$$V_{out} = 0.025 \times \text{weight } (\textit{Kgs}.)$$

The system monitors the output of the load cells and finds out the total weight by taking the average of the three values that are sensed by each load cell.
This value is displayed on a seven-segment display. When this value exceeds 99 kgs, an output port, which is connected to a relay, is switched on to sound an alarm.

Design the necessary hardware and software for implementing the above-mentioned task.
Once the objects are placed on the load cell user presses a switch labelled **weigh**.

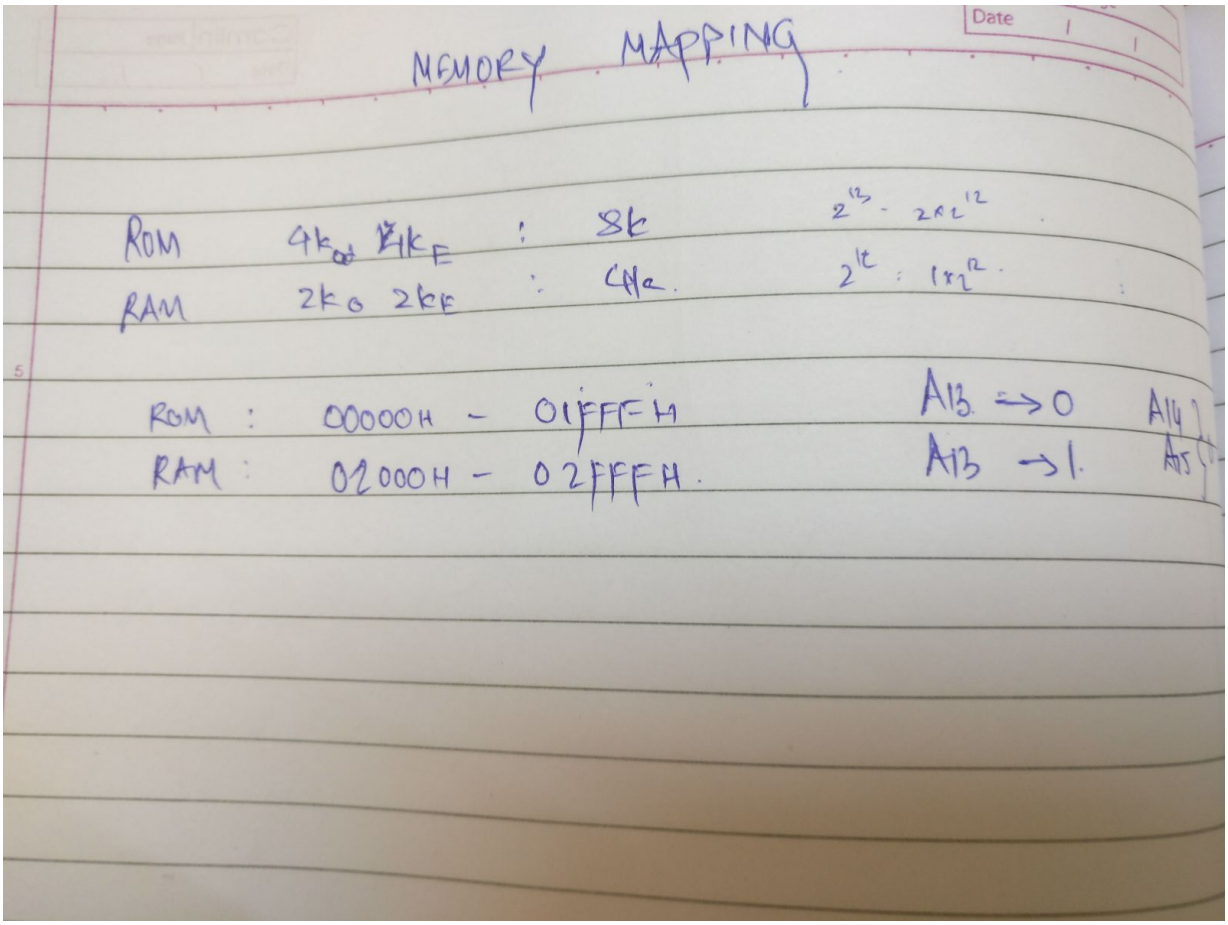
ASSUMPTIONS

1. The starting address of ROM is 00000_h
2. The starting address of RAM is 02000_h
3. The maximum capacity of weight that can be measured by each load cell is 300kgs but the ADC can measure only up to 256 bytes. Since we are using an 8 bit ADC (ADC 0808).
4. Once the user reloads the weights, he has to toggle the switch ‘weigh’ again to start measurement of the new weights.
5. The buzzer will be on until the simulation is stopped.
6. Each load cell gives very low voltage output (mV) which has to be amplified since the 0808 ADC works in the range of volts.

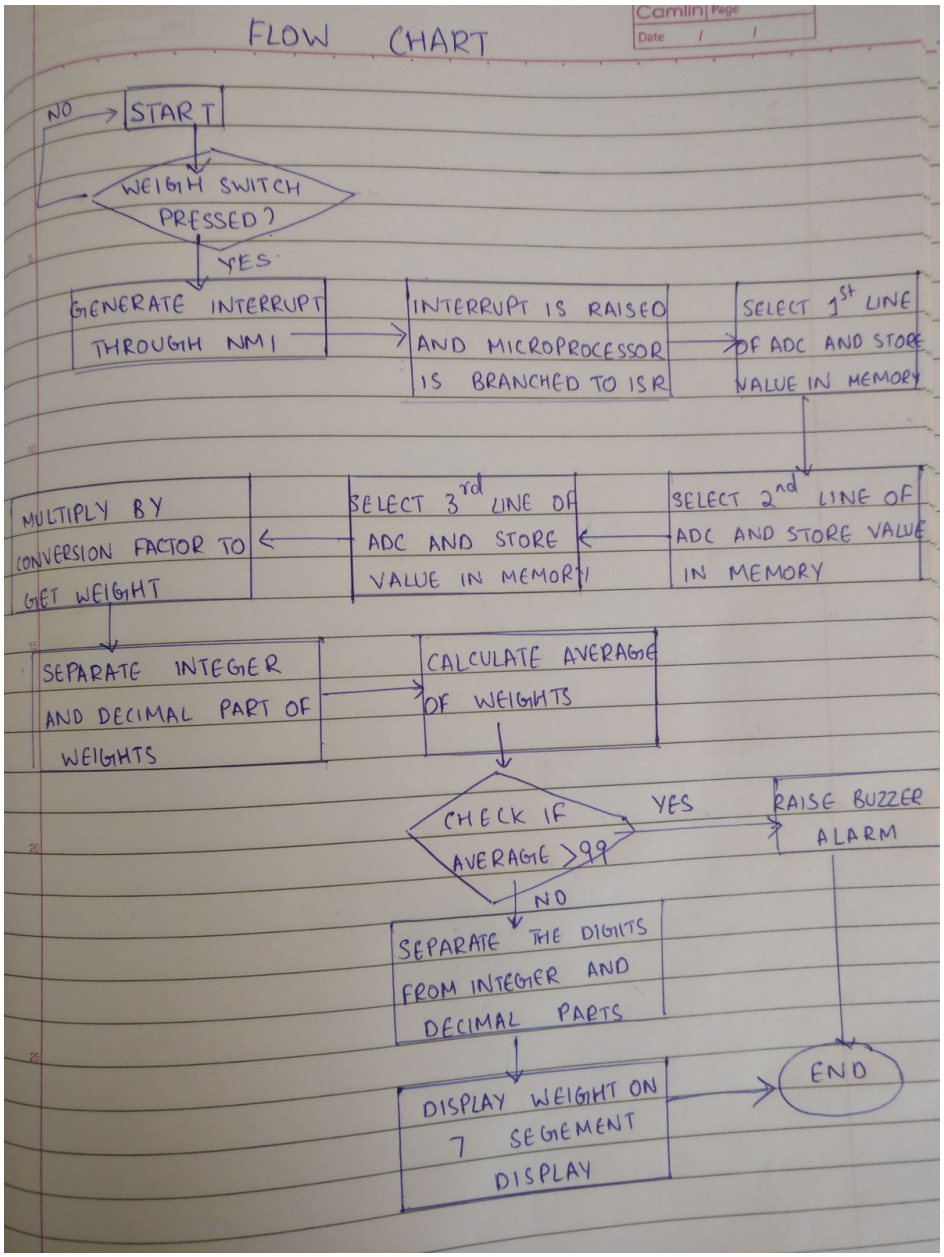
COMPONENTS USED

Description	Name	Quantity
Microprocessor	8086	1
Programmable Peripheral Interface	8255	2
Analog to Digital Converter	0808	1
Load Cell	Combination of op amp and resistors	3
Relay(12V)	Relay	1
Buzzer(12V)	Buzzer	1
7 segment display	Common Anode	2
BCD to 7 segment converter	7447	1
Switch	SPDT	2
Op Amp	INA122	3
RAM	6116 (4k)	2
ROM	2732 (8k)	2
OR GATES	IC 7432	1
CLOCK GENERATOR	8284	1
LATCHES	74LS373	3
BUFFERS	74LS245	2
3 TO 8 DECODER	74LS138	2

MEMORY MAPPING



FLOWCHART


FLOW CHART
START
NO
WEIGH SWITCH PRESSED?
YES
GENERATE INTERRUPT THROUGH NMI
INTERRUPT IS RAISED AND MICROPROCESSOR IS BRANCHED TO ISR
SELECT 1st LINE OF ADC AND STORE VALUE IN MEMORY
SELECT 2nd LINE OF ADC AND STORE VALUE IN MEMORY
SELECT 3rd LINE OF ADC AND STORE VALUE IN MEMORY
MULTIPLY BY CONVERSION FACTOR TO GET WEIGHT
SEPARATE INTEGER AND DECIMAL PART OF WEIGHTS
CALCULATE AVERAGE OF WEIGHTS
CHECK IF AVERAGE >99
YES
RAISE BUZZER ALARM
NO
SEPARATE THE DIGITS FROM INTEGER AND DECIMAL PARTS
DISPLAY WEIGHT ON 7 SEGEMENT DISPLAY
END

SIMULATION RESULTS

V1	V2	V3	Average weight displayed (in Kgs)
1.5	1.5	1.5	60
1.5	1.5	2.5	73
1.5	2.5	2.5	86
2.5	2.5	2.5	Buzzer

SCOPE OF IMPROVEMENT

The decimal values can also be displayed by using more 7 segment displays.

APPENDIX

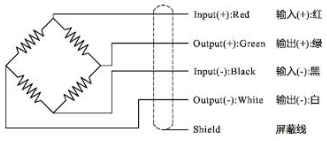
LOAD SENSOR

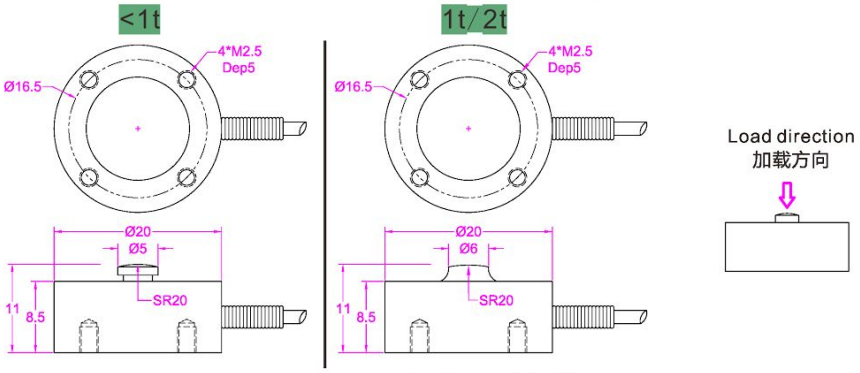
Measure it right
Forsentek

Weighing || Measuring || Controlling

Model:FC20

Wiring Diagram/接线图





--- Specifications / 规格参数 ---

Capacity/量程	5/10/20/30/50/100/200/300/500/1000/2000kg		
Rated Output 额定输出	1.2~1.8mV/V	Compensated Temp. 温度补偿范围	-10...+40°C
Excitation 激励电压	5~12V	Operating Temp. 工作温度范围	-20...+60°C
Zero Balance 零点输出	±3% of R.O.	Temp. Shift Zero 零点温度漂移	±0.01% of R.O./°C
Nonlinearity 非线性	±0.5% of R.O.	Temp. Shift Span 灵敏度温度漂移	±0.01% of R.O./°C
Hysteresis 滞后	±0.5% of R.O.	Input Resistance 输入阻抗	350±30Ω
Nonrepeatability 非重复性	±0.2% of R.O.	Output Resistance 输出阻抗	350±3Ω
Creep(30min) 蠕变	±0.2% of R.O.	Insulation Resistance 绝缘阻抗	>5000MΩ(50V)
Safe Overload 安全过载	150% of F.S.	Ingress Protection 防护等级	IP65
Ultimate Overload 极限过载	200% of F.S.	Material of Element 弹性体材料	Stainless steel 不锈钢
Cable 导线	Ø3*1000mm 4-core shielded cable Ø3*1000mm 4芯屏蔽线		
R.O.=Rated Output/额定输出 F.S.=Full Scale/满量程			

• Subject to change without notice / 如有更改,不另行通知

Forsentek Co., Limited •Web: www.forsentek.com •Email: sales@forsentek.com

BUZZER

MICRO BUZZER 5V DC / 20mA PCB TYPE - SEALED

Order Code: SV4/5-S

RoHS

ROHS Info

Features

- sealed: yes
- operating power: 3-6V DC / 25mA
- extremely compact, ultrathin construction
- no electrical noise
- low current consumption yet high sound pressure level

Specifications

- tone type: single
- operating voltage: 3-6VDC
- rated voltage: 5V DC
- current consumption: 25mA
- osc. frequency: 3.2kHz
- sound level: 87dB
- connector type: pcb
- body color: gray
- weight: 0.056oz

More...

Stock Info

RELAY

RELAY PRODUCTS

General Purpose Relays
PCB Relays

SCHRACK

Power PCB Relay RT1 bistable

- 1 pole 16A, 1 form C (CO) or 1 form A (NO) contact
- Polarized bistable version with 1 or 2 coils
- 5kV/10mm coil-contact
- Reinforced insulation

Typical applications
Battery powered equipment or applications with "memory function"

Approvals

VDE Cert. No. 40007571, UL E214025, cCSAus 1142018
Technical data of approved types on request

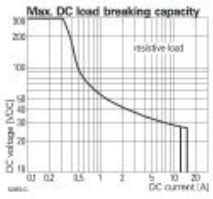
Contact Data

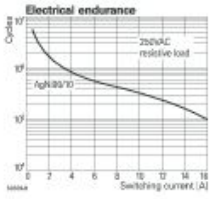
Contact arrangement	1 form C (CO) or 1 form A (NO)
Rated voltage	250VAC
Max. switching voltage	400VAC
Rated current	16A
Limiting continuous current	16A, UL: 20A
Limiting making current, max. 4s, duty factor 10%	30A
Breaking capacity max.	4000VA
Contact material	AgNi 90/10
Frequency of operation, with/without load	360/7200h^{-1}
Operate/Reset time max.	10/10ms
Bounce time max., form A/form B	3/6ms

Contact ratings

Type	Contact	Load	Cycles
IEC 61810			
RT314	A (NO)	16A, 250VAC resistive, 85°C	30x10^3
RT314	C (CO)	16A, 250VAC resistive, 85°C	10x10^3
UL 508			
RT314	A/B (NO/NC)	20A, 250VAC, general purpose, 85°C	6x10^3
RT334	A (NO)	16A, 250VAC, general purpose, 85°C	50x10^3
RT314	A (NO)	1hp, 240VAC, 40°C	1x10^3

Mechanical endurance >5x10^6 operations





Coil Data, bistable coils

	1 coil	2 coils
Magnetic system	polarized, bistable	
Coil voltage range	3 to 24VDC	
Operative range, IEC 61810	2	
Limiting voltage, % of rated coil voltage	120%	150%
Min./Max. energization duration	30ms/1min at <10% duty factor	
Coil insulation system according UL1446	class F	

Coil versions, bistable coil

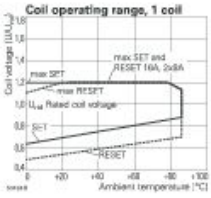
Coil code	Rated voltage VDC	Set voltage VDC	Reset voltage VDC	Coil resistance Ω±10%	Rated coil power mW
bistable 1 coil					
A03	3	2.1	1.7	21	429
A05	5	3.5	2.8	62	403
A06	6	4.2	3.3	90	400
A12	12	8.4	6.6	360	400
A24	24	16.8	13.2	1440	400
bistable 2 coils					
F03	3	2.1	1.7	15	600
F05	5	3.5	2.8	42	595
F06	6	4.2	3.3	55	655
F12	12	8.4	6.6	240	600
F24	24	16.8	13.2	886	650

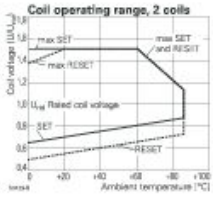
All figures are given for coil without pre-energization, at ambient temperature +23°C.
Other coil voltages on request.

Bistable coils - operation

Version	1 coil		2 coils		
Coil terminals	A1	A2	A1	A3	A2
Operate	+	-	+	-	
Reset	-	+	-	+	

Contact position not defined at delivery





Links to Datasheets

INA122:
http://www.ti.com/lit/ds/symlink/ina122.pdf
ADC0808:
http://www.ti.com/lit/ds/symlink/adc0809-n.pdf
8255:
http://www.eie.polyu.edu.hk/~enyhchan/c8255.pdf
8086:
http://www.datasheetspdf.com/PDF/8086/499305/5
7447:
http://www.datasheetcatalog.com/datasheets_pdf/D/M/7/4/DM7447A.shtml
8284:
http://www.datasheetspdf.com/datasheet/8284A.html
74138:
http://www.ti.com/lit/ds/symlink/sn74ls138.pdf
2732:
http://pdf1.alldatasheet.com/datasheet-pdf/view/129050/FAIRCHILD/2732.html
6116:
http://www.princeton.edu/~mae412/HANDOUTS/Datasheets/6116.pdf

Google Drive Link for design and codes:

https://drive.google.com/drive/folders/0B5PBPkQRVLbucDdLRkdJZ3daT3c