Experiment 7:
Binary Coded Decimal (BCD) to Decimal Digit Conversion with Seven-Segment Display

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EEL3702C
Digital Logic Design
Section 04
Professor: Dr. Balasubramaniyan Chandrasekaran

Experiment No. 7: Binary Coded Decimal (BCD) to Decimal Digit Conversion with Seven-Segment Display

Objective:

To learn about the types of 7-segment display

To set up and test a 7-segment static display system to display decimal digits 0-9

Experimental Equipment:

- 74LS08 quad 2-input AND TTL IC
- 74LS32 quad 2-input OR TTL IC
- 74LS86 2-input XOR TTL IC
- 74LS266 2-input XNOR TTL IC
- 7-segment display (common anode)
- DC Voltmeter
- +5V Power supply
- Bread Board
- Light Emitting Diode
- Connecting Wires

In addition to above equipment's, you are free to use any other logics gates that is needed if you think.

Procedure:

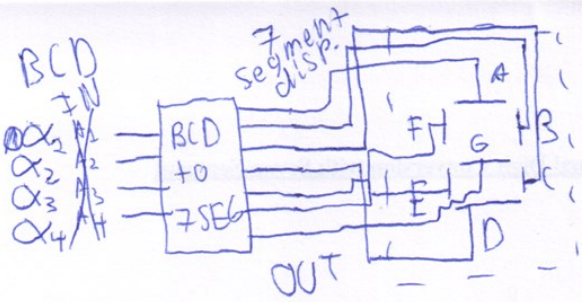
1. From the specifications of the problem (BCD to 7-segment display), determine the required number of inputs and outputs and assign a symbol to each

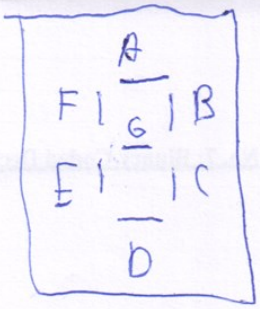
2. Derive the truth table that defines the required relationship between inputs and outputs.

3. Obtain the simplified Boolean function for each output as a function of the input variables

4. Design/ Draw the Logic diagram using logic gates that mentioned above

5. Implement your design and verify the correctness of your design.

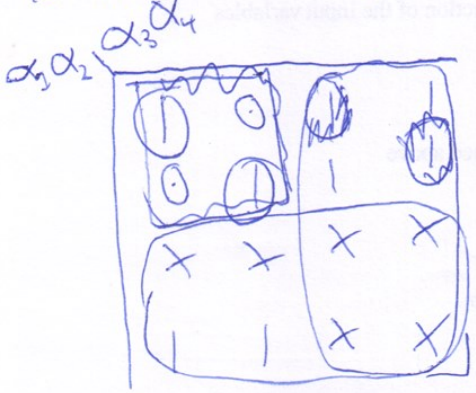


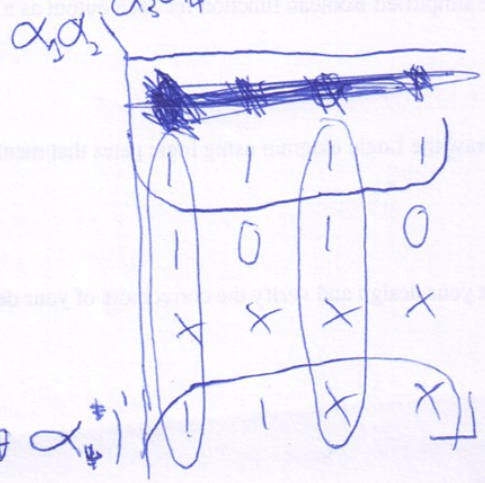


A_4	α_2	α_2	α_3	α_4	A	B	C	D	E	F	G
0	0	0	0		1	1	1	1	1	1	0
0	0	0	1		0	1	1	0	0	0	0
0	0	1	0		1	1	0	1	1	0	1
0	0	1	1		1	1	1	1	0	0	1
0	1	0	0		0	1	1	0	0	1	1
0	1	0	1		1	0	1	1	0	1	1
0	1	1	0		1	0	1	1	1	1	1
0	1	1	1		1	1	1	0	0	0	0
1	0	0	0		1	1	1	1	1	1	1
1	0	0	1		1	1	1	✗	0	1	1
1	0	1	0		1	1	1	1	1	1	1
1	0	1	1		1	1	1	1	1	1	1

Nine can have 2 outputs (beyond DEC 9 ; input, all outputs don't cares)

K-maps (one for each segment)





$A = \alpha_1 + \alpha_3 + (\alpha_2 \oplus \alpha_4)'$

$B = \alpha_2' + (\alpha_3 \oplus \alpha$

Please follow the guidelines when you submit your lab report

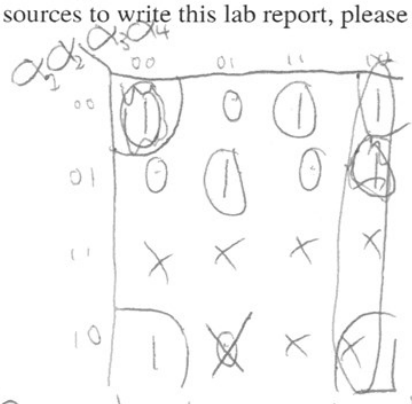
First Page in your lab report:

- Experiment Number, Experiment Name, Student's Information (Name, ID, etc), and Course Information (Course No, Course Title, Course Section etc.)

Second Page in your lab report

- Objectives
- Experimental Equipment
- Methods Description/Procedures (Logic diagram, Truth Table, IC pin diagram)
- Results and Discussion (Actual results and your observation results)
- Conclusion (what you learn from this experiment)
- References (if you use any other sources to write this lab report, please reference it)

$C = \alpha_4 + \alpha_3'\alpha_4 + \alpha_2$



$D = \alpha_2'\alpha_4' + \alpha_3\alpha_4' + (\alpha_2 \oplus \alpha_3)$

E

F

G

$E = \alpha_2'\alpha_4' + \alpha_3\alpha_4'$

$= \alpha_4'(\alpha_2' + \alpha_3)$

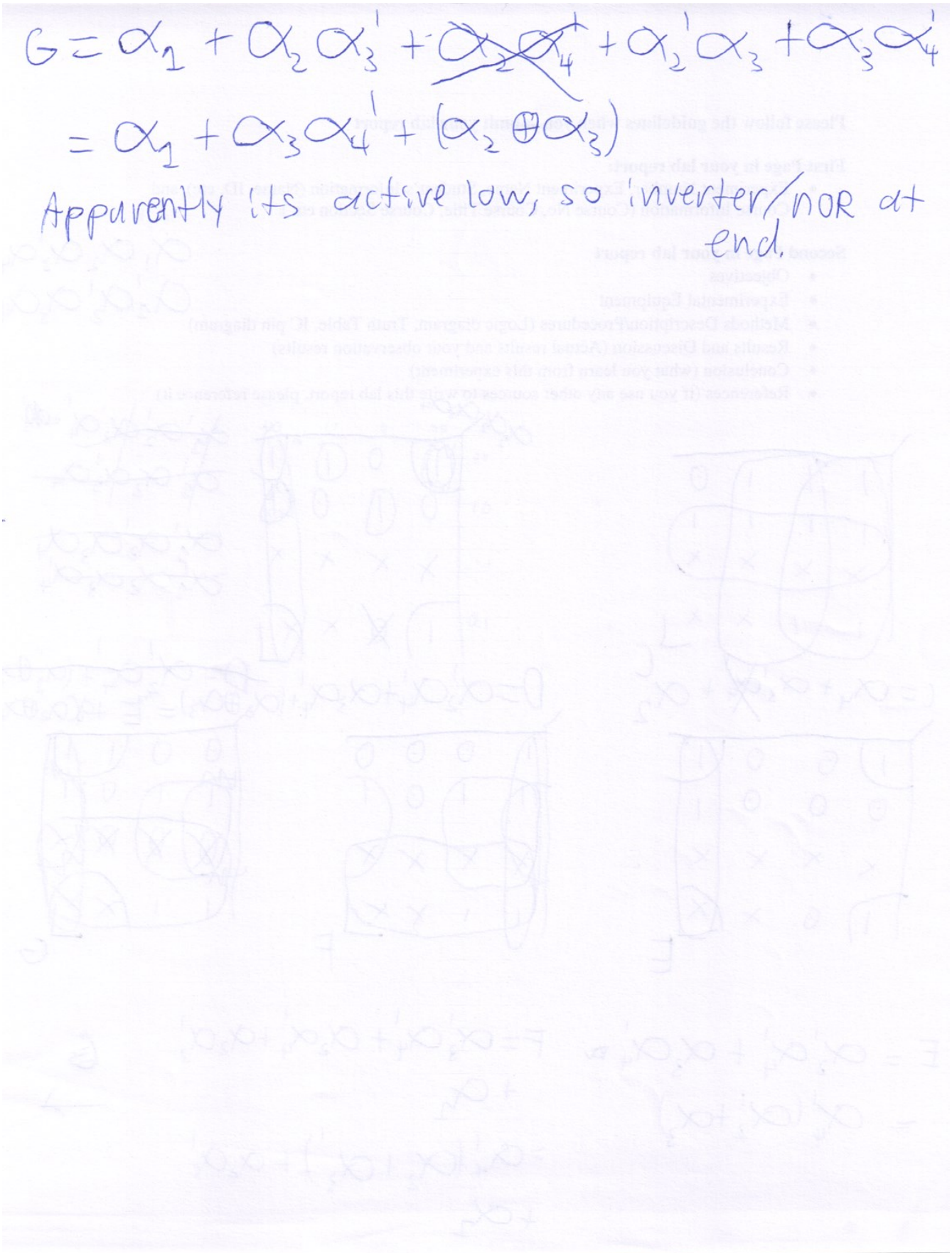
$F = \alpha_3'\alpha_4' + \alpha_2\alpha_4' + \alpha_2\alpha_3' + \alpha_2$

$= \alpha_4'(\alpha_2 + \alpha_3')' + \alpha_2\alpha_3' + \alpha_2$

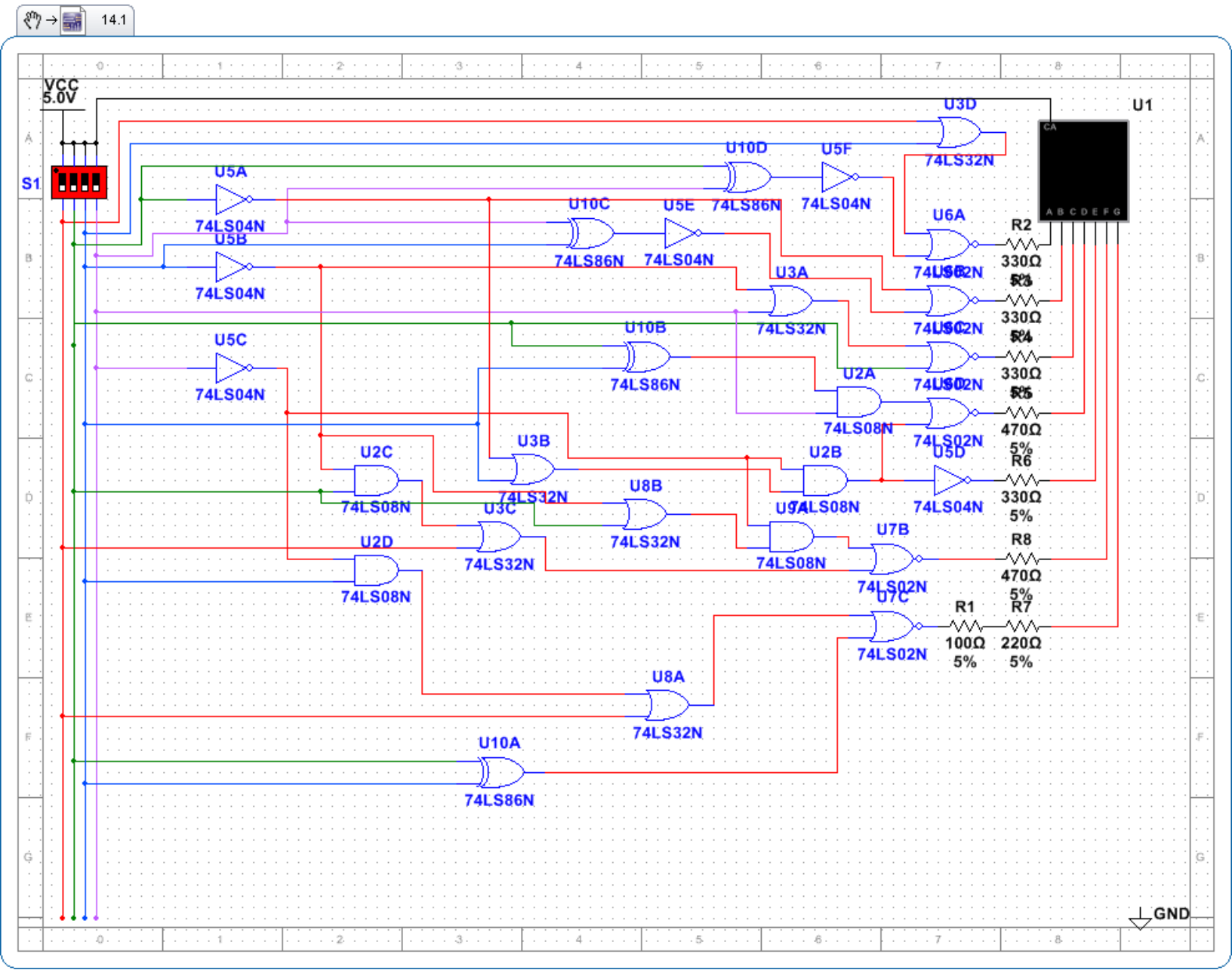
$G = \alpha_1 + \alpha_2\alpha_3' + \alpha_2\alpha_4' + \alpha_2'\alpha_3 + \alpha_3\alpha_4'$

$= \alpha_1 + \alpha_3\alpha_4' + (\alpha_2 \oplus \alpha_3)$

Appurently its active low, so inverter/NOR at end.



Note: Active low for simulation in Multisim.



Note: Circuit design only used gates that were readily available.

EEL3702C
Lab Check off Sheet

Please bring a print out of this sheet before demonstrating your working circuit. Attach this check off sheet with the Lab report.

Note: Lab check off sheet should be signed by the Instructor or TA. Lab reports without the check off sheet will not receive credit.

Name: Peter Dranishnikov

Section: 04

Experiment: 7

Lab Demonstration Comments:

03/16

Signature of Instructor/TA:

Date:

Results/Discussion:

For the actual laboratory session, by the discretion of the professor, a single chip, the SN74LS47 BCD to 7-Segment decoder was used. The chip functioned and showed all 10 digits as per the specifications of its datasheet. The original circuit is still useful for questions outside of this laboratory assignment.

Conclusion:

Medium-scale integration circuits can be designed and constructed tediously using basic gates or by using a market solution (the MSI chip referenced).

References:

Texas Instruments, *SN74LS47 Datasheet*

Generic Datasheet (attached on subsequent pages), *1 Digit Seven Segments LED Display [sic]*

规 格 书
Specifications

品名 **Name**	1 位数码管 1 Digit Seven Segments LED Display
型号 **Model**	**K** **YX-3101A** (共阴 Share Cathode)
	K **YX-3101B** (共阳 Share Anode)
发光颜色 **Color**	红-R 超亮红-SR 黄绿-G 黄-Y 蓝-B 翠绿-PG 白-W **Red-R, Super Red-SR, Yellow Green-G, Yellow-Y, Blue-B, Pure Green-PG, White-W**
8 字高度 **"8" Height**	0.3英寸 7.80m m 0.3inch, 7.80m m
总芯片数 **Total LED Chips**	**9**
表面颜色 **Cover Color**	黑色 **Black**
胶体颜色 **Colloid Color**	乳白/红 **Ivory/Red**
备注 **Remark**	

一.特性描述（Characteristics）

★★★ 能在低电压、小电流条件下驱动发光
Lower working voltage and current

★★★ 发光响应时间极短(<0.1μs),高频特性好,单色性好,亮度高
Lighting answering Time <0.1μs, better high frequency, chromaticity uniformity, high brightness.

★★★ 体积小,重量轻,抗冲击性能好. 固态封装，封装方式为灌胶型,稳定性高
Smaller volume, lighter weight, better impact resistance, solid sealing, good steady.

★★★ 寿命长,使用寿命在 5 万小时以上
Long life for 50,000 hours.

★★★ 可连续扫描驱动各字节
Keep scaning and drivering every segment continuously.

★★★ 良好的显示效果、视角宽
Better showeffect and wider visual angle.

★★★ 推荐恒流使用,恒压会出现亮度不均匀现象
Recommend constant current driver.

★★★ 表面有保护膜的产品,可以在使用前撕下来
Protective coating, and rip off when using.

★★★ 焊接温度: 260°C　停留时间最长5 秒
Solder temperature: 260°C,and stay time less than 5 seconds.

★★★ 当工作温度高于 25°C时， Ifm,ifp 和Id 必须降低;电流降低率是-036mA/°C(直流驱动)， 或-0.86mA/°C (脉冲驱动)功耗率是-0.75mW/°C。产品的工作电流不能大于对应工作温度条件 Ifm 或Ifp 的60%。For operation above 25°C,The Ifm Ifp & Pd must be derated,the Current derating is-0.36Ma/°C for DC drive and -0.86mA/°C for pulse drive,the power dissipation is -0.75mW/°C.The product working current must not more than the 60% of the Ifm or Ifp according to the working temperature.

★★★ 蓝色,翠绿色,白色请采取防静电措施
Electrostatic prevention for Blue, Pure Green and White ones.

二. 极限参数（**Limited Parameters**）

参数 Parameters	符号Symbol	极限参数 Limited parameter
脉冲电流Peak Forward Current	Ifp	100mA
直流电流Continuous Forward Current	If	20 mA
反向电压Reverse Voltage	Vr	5V
工作温度Operating temperature Range	Topr	-30 to +70℃
储存温度 Storage temperature Range	Tstg	-40 to +85℃

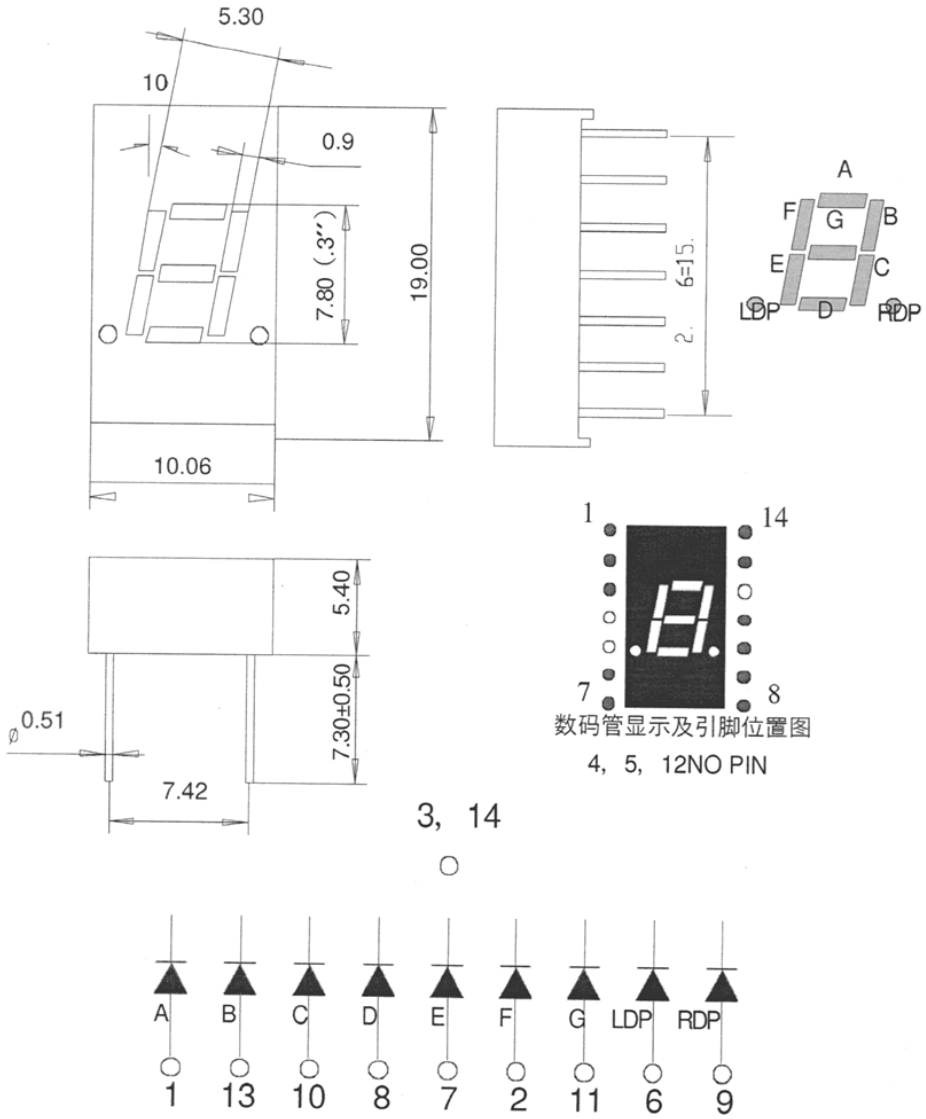
三. 光电参数（**Photoelectric Parameters**）

参数Parameter	正向电压 Forward voltage		反向电流 Reverse current		发光强度 Luminous Intensity	波长 Wavelength	功耗 Power consumption
符号 Name	VF		IR		IV	λp	Pt
单位 Unit	V		uA		mcd	nm	mW
条件Condition	IF=20 mA		VR=5V		IF=20mA	IF=20mA	IF=20mA
	平均 Arrange	最大 Max.	平均 Arrange	最大 Max.	平均 Arrange	平均 Arrange	平均 Arrange
高亮红 High red **R**	2	2.4	--	20	11	635	36
超高亮红 super red **SR**	2.2	2.6	--	20	80	620	40
黄绿色 Yellow green **G**	2.2	2.6	--	20	11	571	44
黄色 Yellow **Y**	2.1	2.5	--	20	85	590	42
蓝色Blue **B**	3.3	4	--	20	12	465	66
翠绿色Pure green **PG**	3.3	4	--	20	220	515	66
白色White **W**	3.3	4	--	20	--	--	66

四.外形尺寸及电路原理图: 10.06mm×19.00mm×5.40mm

Figure Size & Circuit Principle Diagram : 10.06mm×19.00mm×5.40mm

3101A



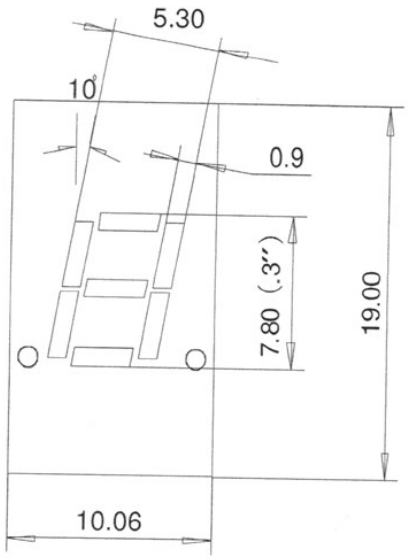
段驱动电压为: 正向电压×1

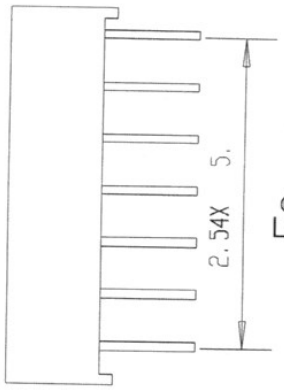
Segment driver voltage: VF value x 1

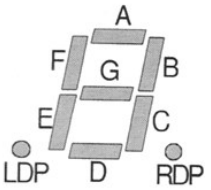
小数点驱动电压为: 正向电压×1 不同颜色的正向电压值不同,详见第二页光电参数表.

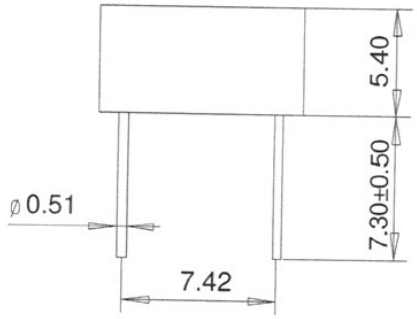
Decimal driver voltage: VF value x 1, different colors with different forward voltage, please refer to Photoelectric Parameters.

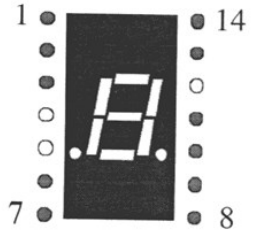
3101B







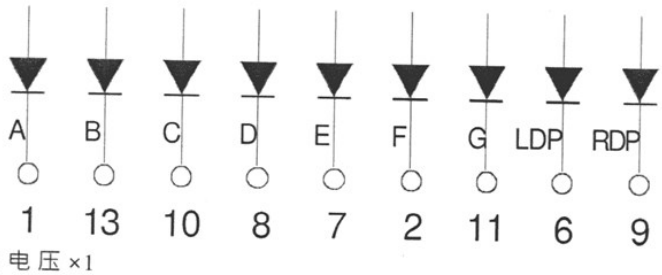




数码管显示及引脚位置图

4, 5, 12 NOPIN

3, 14



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