DAILY REPORT #13

발표자 : 신홍민

1. Design for Ambient LED Lighting Circuit

Mouser 번호:	755-SMLEN3WBC8W1
제조업체 번호:	SMLEN3WBC8W1
제조업체:	ROHM Semiconductor
If - 순방향 전류:	5 mA
Vf - 순방향 전압:	2.9 V

5. ELECTRO-OPTICAL CHARACTERISTICS (Ta=25°C)

DESCRIPTION	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNITS
Forward Voltage	VF	IF=5mA 2)	2.5	2.9	3.3	V
Reverse Current	IR	VR=5V	-	-	10	μA

< Figure 1 > SMLEN3WBC8W1 Spec.

●Electrical characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Collector-base breakdown voltage	BV_{CBO}	I_C = 50μA	20	-	-	V
Collector-emitter breakdown voltage	BV_{CEO}	I_C = 1mA	20	-	-	V
Emitter-base breakdown voltage	BV_{EBO}	I_E = 50μA	5	-	-	V
Collector cut-off current	I_{CBO}	V_{CB} = 20V	-	-	100	nA
Emitter cut-off current	I_{EBO}	V_{EB} = 5V	-	-	100	nA
Collector-emitter saturation voltage	$V_{CE(sat)}$	I_C = 100mA, I_B = 10mA	-	120	300	mV
DC current gain	h_{FE}	V_{CE} = 2V, I_C = 1mA	120	-	560	-
Transition frequency	f_T	V_{CE} = 10V, I_E = -10mA, f = 100MHz	-	400	-	MHz
Output capacitance	C_{ob}	V_{CB} = 10V, I_E = 0A, f = 1MHz	-	2.0	-	pF

< Figure 2 > Q2SCR522M Spec.

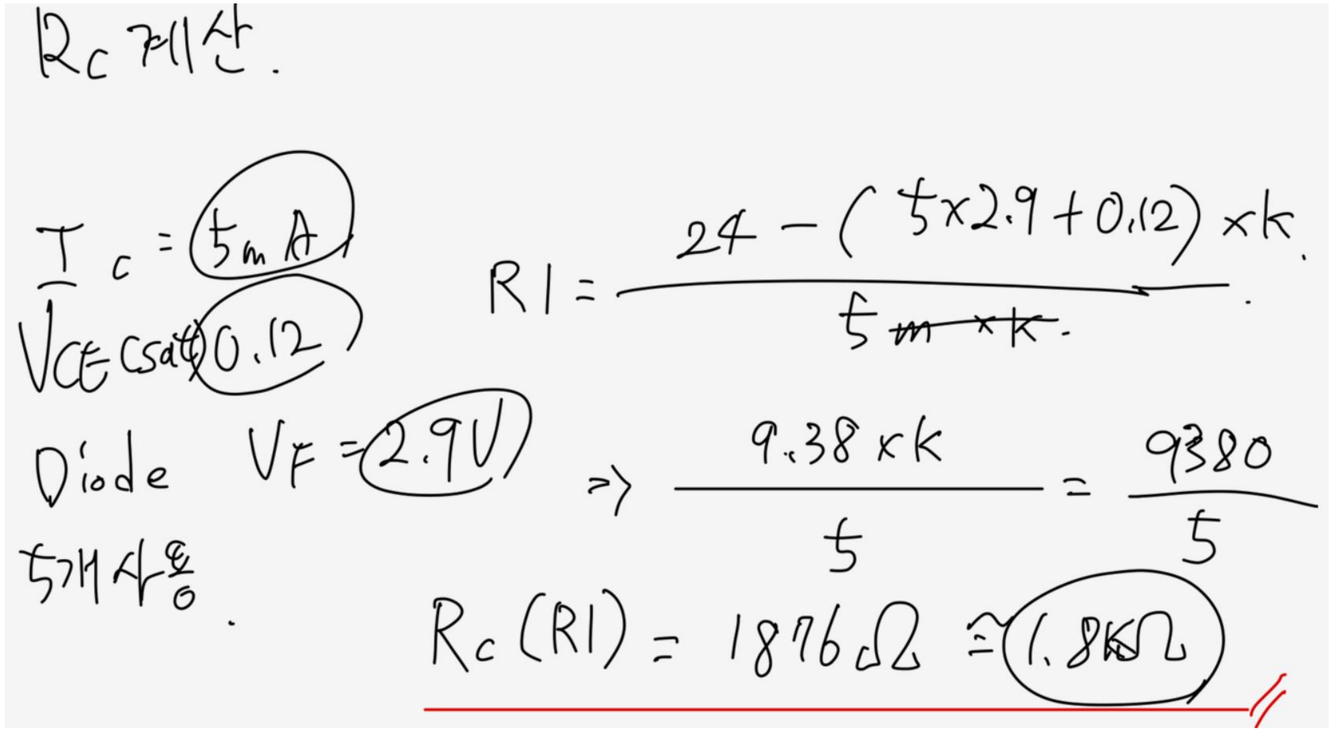
- **사용 소자**
  - ➢ 다이오드 :
    SMLE13WBC8W1(단종 이슈) -> SMLEN3WBC8W1 변경
    - ✓ $V_F = 2.9V$
    - ✓ $I_F = 5mA$
  - ➢ TR : Q2SCR522M
    - ✓ $I_C = 5mA$
    - ✓ $V_{CE(sat)} = 120mV$
- **공급 전압** : 24Vdc
- **제어입력**
  - ➢ Freq : 1kHz, Duty = 50%

가격 (KRW)

수량	단가	합계
컷 테이프/MouseReel™		
1	₩750	₩750
10	₩520.7	₩5,207
100	₩375	₩37,500
500	₩309.9	₩154,950
1,000	₩270.3	₩270,300
전체 릴(5000의 배수로 주문)		
5,000	₩249	₩1,245,000
10,000	₩229.2	₩2,292,000
25,000	₩222.2	₩5,555,000

1. Design for Ambient LED Lighting Circuit

- ***R_C Calculate***
  - ➢ $R_C = \frac{V_H - (5\ X\ V_F + V_{CE.(sat)})}{I_C} \cong 1.8\text{k}\Omega$
  - ➢ 1.8kΩ은 표준저항값(±5%)에 포함되어 그대로 사용



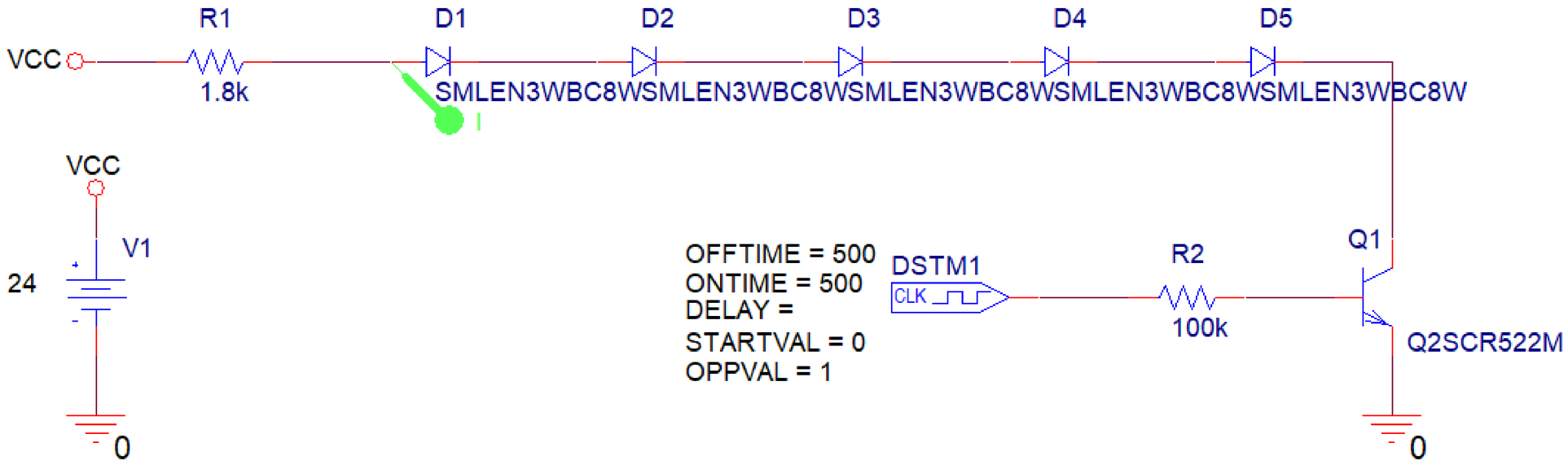
< Figure 3 > *R_C Calculate Result*

< 5% 오차율을 갖는 표준저항값 >

1.0	10	100	1.0K	10K	100K	1.0M
1.1	11	110	1.1K	11K	110K	1.1M
1.2	12	120	1.2K	12K	120K	1.2M
1.3	13	130	1.3K	13K	130K	1.3M
1.5	15	150	1.5K	15K	150K	1.5M
1.6	16	160	1.6K	16K	160K	1.6M
1.8	18	180	1.8K	18K	180K	1.8M
2.0	20	200	2.0K	20K	200K	2.0M
2.2	22	220	2.2K	22K	220K	2.2M
2.4	24	240	2.4K	24K	240K	2.4M
2.7	27	270	2.7K	27K	270K	2.7M
3.0	30	300	3.0K	30K	300K	3.0M
3.3	33	330	3.3K	33K	330K	3.3M
3.6	36	360	3.6K	36K	360K	3.6M
3.9	39	390	3.9K	39K	390K	3.9M
4.3	43	430	4.3K	43K	430K	4.3M
4.7	47	470	4.7K	47K	470K	4.7M
5.1	51	510	5.1K	51K	510K	5.1M
5.6	56	560	5.6K	56K	560K	5.6M
6.2	62	620	6.2K	62K	620K	6.2M
6.8	68	680	6.8K	68K	680K	6.8M
7.5	75	750	7.5K	75K	750K	7.5M
8.2	82	820	8.2K	82K	820K	8.2M
9.1	91	910	9.1K	91K	910K	9.1M

< Table 1 > 표준 저항값(±5%)

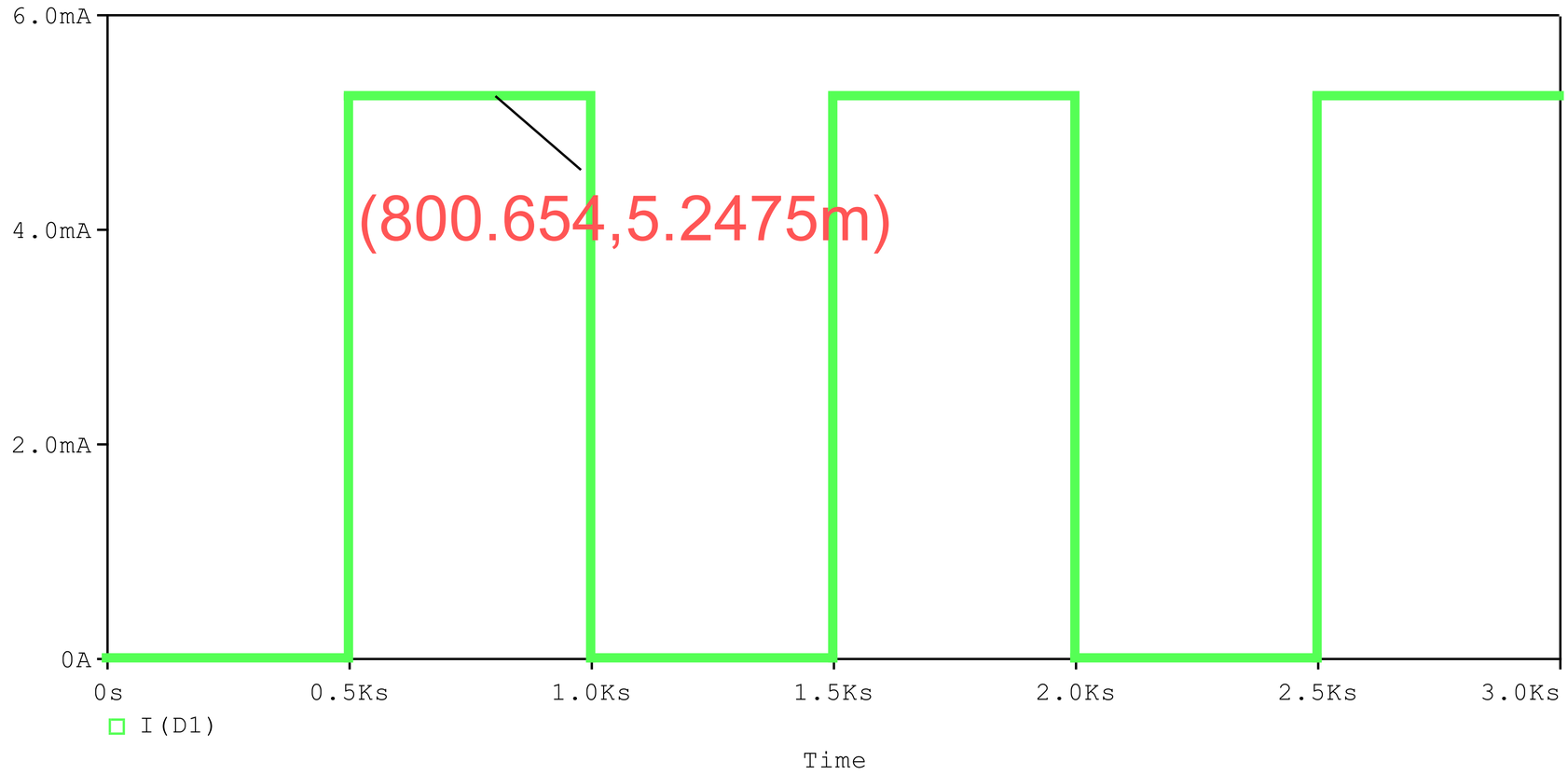
1. Design for Ambient LED Lighting Circuit



< Figure 4 > Ambient LED Lighting Circuit

- R_C(R1) Value = 1.8kΩ
- R_B(R2) Value = 100kΩ
  - ➢ 이유 : 공급전압이 24Vdc로 높기에 5Vdc에서의 $R_B$value(10~47k Ω)를 고려하여 충분히 높게 설정

1. Design for Ambient LED Lighting Circuit



< Figure 5 > Simulation Result

- Simulation Result
  - ➢ VCC에 24Vdc의 전압이 인가된 후 LOW일때 LED가 동작하는 것을 확인

2. Change the Ambient LED Lighting Circuit

- ***R_C Calculate***

R_C

$V_H = 5V$

$I_C = 5mA \times 5$

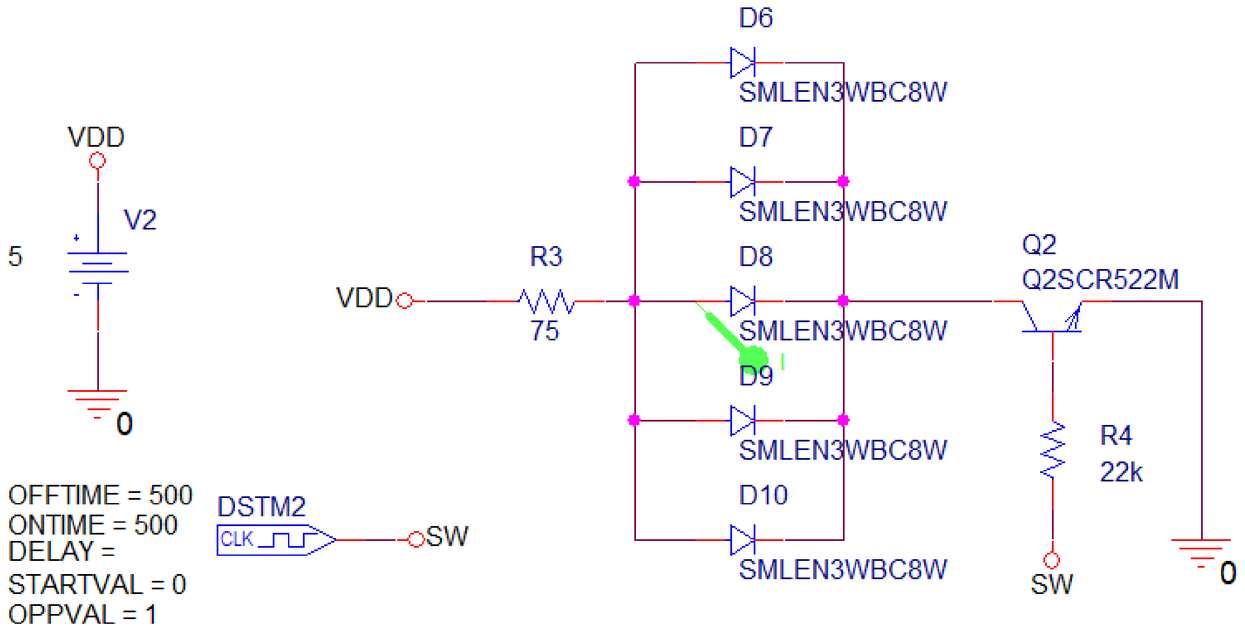
$I_{CE.sat} \simeq 0.12V$

$V_F(LED) = 2.9V$

$$R_C = \frac{5 - (2.9 + 0.12)}{25m} = \frac{1980}{25} = 79\Omega \simeq 75\Omega$$

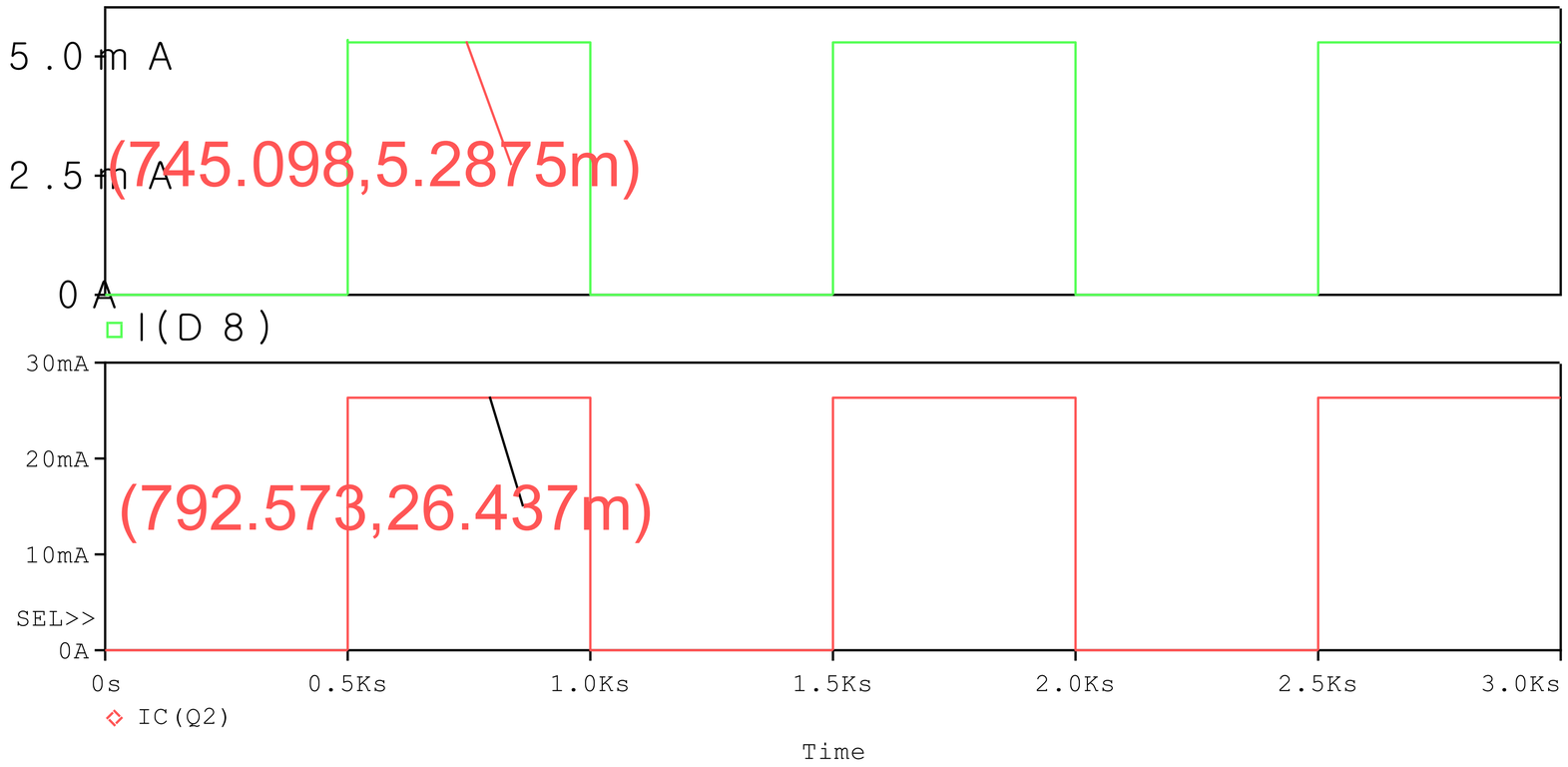
< Figure 6 > *R_C Calculate Result*

- 공급전압 5V에 맞추어 재설계 진행
- 기존 회로로는 5mA의 전류가 흐르지 않는 문제 확인
- 기존방식으로 R_C값을 계산 시 음수가 나오므로 부적합함
- 다이오드를 병렬로 연결(Total $V_F$value = 2.9V)
  - ➢ $R_C = \frac{V_H - (V_F + V_{CE.(sat)})}{I_C} \cong 79\Omega$
  - ➢ 79Ω은 표준저항값(±5%)에 없기에 75Ω로 낮추어 사용



< Figure 7 > Ambient LED Lighting Circuit(5V)

2. Change the Ambient LED Lighting Circuit



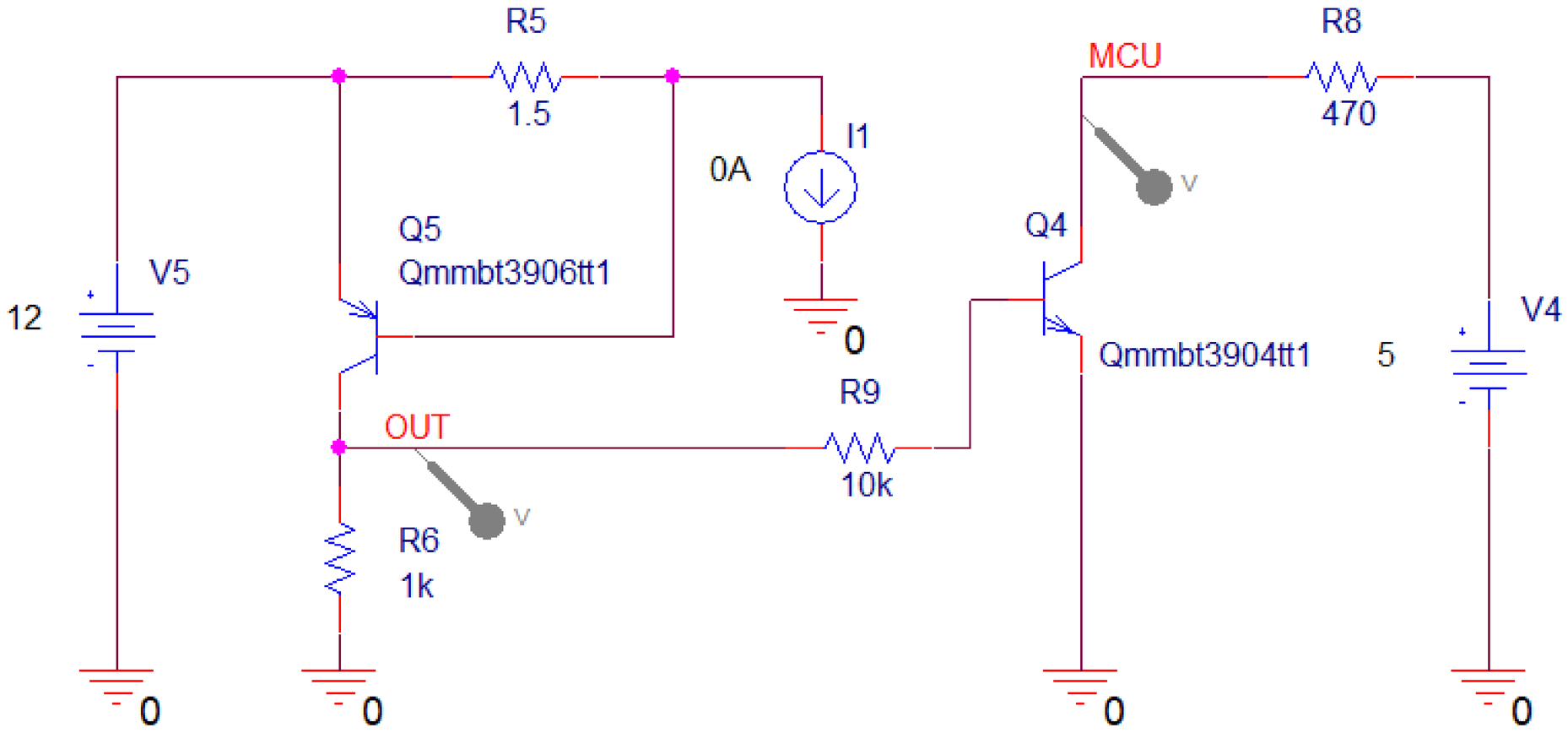
< Figure 8 > Simulation Result

- Simulation Result
  - 공급전압이 LOW일때 5.28mA의 값이 나오는 것을 확인
  - Tr I_C 전류 확인 시 5.28mA의 5배인 26.4mA가 나오는 것을 확인
  - Tr Datasheet상 I_C 전류는 200mA까지 가능

●**Absolute maximum ratings** (T_a = 25°C)

Parameter	Symbol	Values	Unit
Collector-base voltage	V_{CBO}	20	V
Collector-emitter voltage	V_{CEO}	20	V
Emitter-base voltage	V_{EBO}	5	V
Collector current	I_C	200	mA
	I_{CP}*1	400	mA

3. Design for Overcurrent Alarm Circuit



< Figure 9 > Overcurrent Alarm Circuit

- Overcurrent 신호를 IC(Atmega128A)의 Interrupt핀에 보내기 위한 스위칭 회로 추가

3. Design for Overcurrent Alarm Circuit

- R_C *Calculate*

R_C

$I_{CE.sat} = 0.2$

$I_C(Tr) = 10mA$ ($I_{CE.sat} = 0.2$ 의 조건 중 $I_C = 10mA$)

$V_H = 5V$

$$R_C \fallingdotseq \frac{5 - 0.2}{10m} = \frac{4.8}{10} = 480\Omega$$

표준저항값 $\simeq 470\Omega$

Atmega128A의 IO Port의 최대 허용 전류 : 40mA
Tr의 $V_{CE(sat)} = 0.2(I_C = 10mA$ 일때)

< Figure 10 > R_C *Calculate Result*

Electrical Characteristics

Table 32-1 Absolute Maximum Ratings*

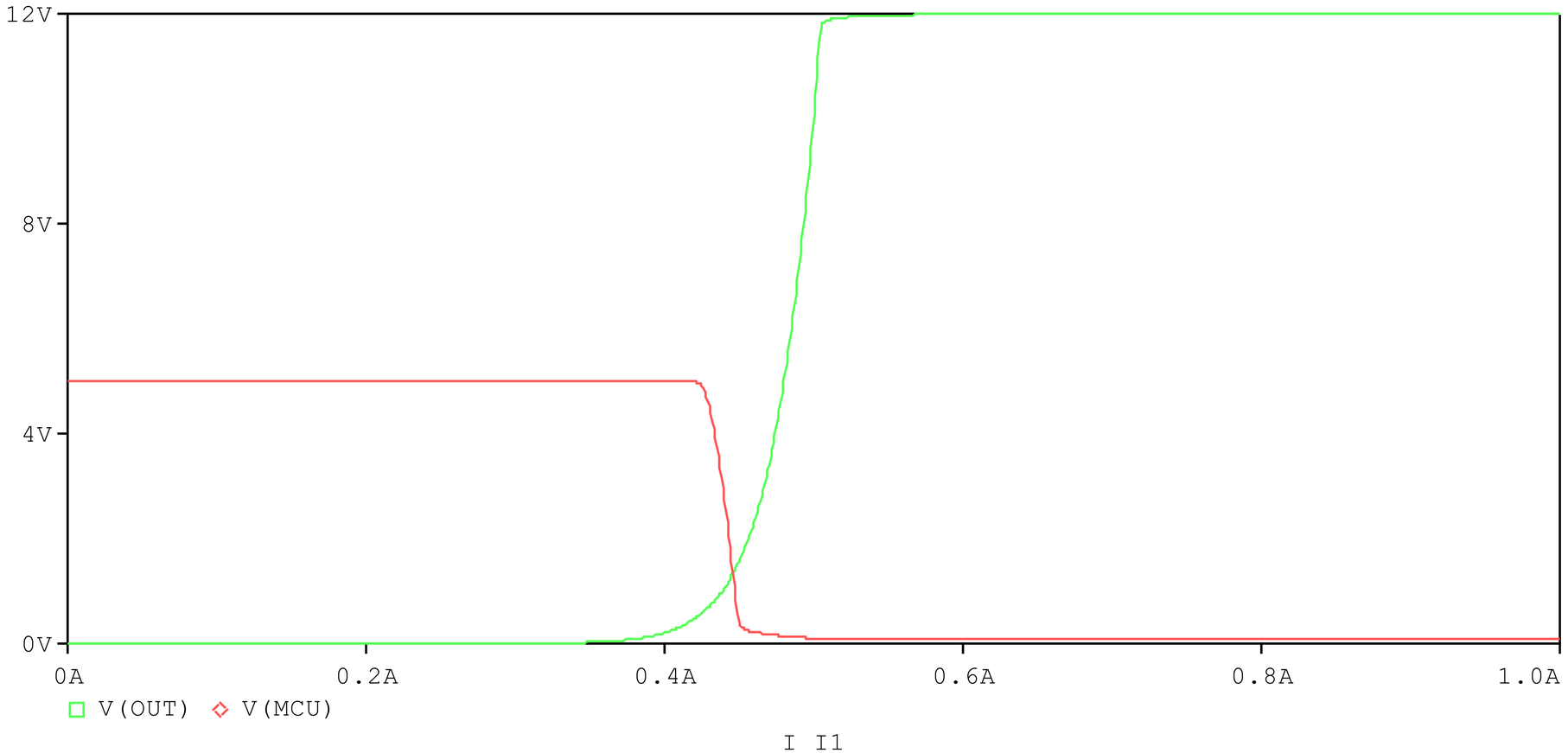
Operating Temperature	-55°C to +125°C	*NOTICE: Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
Storage Temperature	-65°C to +150°C	
Voltage on any Pin except $\overline{\text{RESET}}$ with respect to Ground	-0.5V to V_{CC}+0.5V	
Voltage on $\overline{\text{RESET}}$ with respect to Ground	-0.5V to +13.0V	
Maximum Operating Voltage	6.0V	
DC Current per I/O Pin	40.0mA	
DC Current V_{CC} and GND Pins	200.0 - 400.0mA	

Collector – Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc) (I_C = 50 mAdc, I_B = 5.0 mAdc)	$V_{CE(sat)}$	– –	0.2 0.3	Vdc

< Figure 11 > $ATmega128A$ & TR datasheet

- 위와 같은 이유로 R_C 계산
- 해당 Value를 Circuit에 입력 후 시뮬레이션 진행

3. Design for Overcurrent Alarm Circuit



< Figure 12 > Simulation Result

- Simulation Result
  - Idc 값을 0~1A까지 올렸을 때 추가한 스위칭 회로의 I_C 값이 5V -> 0V로 변화(high -> low)
  - 해당 신호를 ATmega128A의 Interrupt단에 연결 후 low일 때 셧다운 or 스위치 off 등 펌웨어 코드 작성 필요