

TI DSP, MCU / Xilinx Zynq FPGA 프로그래밍 전문가 과정

(LM2576 Buck Regulator Altium Design Procedure)

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Construction

LM2576 소자선정 후 Datasheet의 Application Information을 참고하였다.

<http://www.ti.com/lit/ds/symlink/lm2576.pdf>

LM2576xx Series SIMPLE SWITCHER® 3-A Step-Down Voltage Regulator

1 Features

- 3.3-V, 5-V, 12-V, 15-V, and Adjustable Output Versions
- Adjustable Version Output Voltage Range, 1.23 V to 37 V (57 V for HV Version) $\pm 4\%$ Maximum Over Line and Load Conditions
- Specified 3-A Output Current
- Wide Input Voltage Range: 40 V Up to 60 V for HV Version
- Requires Only 4 External Components
- 52-kHz Fixed-Frequency Internal Oscillator
- TTL-Shutdown Capability, Low-Power Standby Mode
- High Efficiency
- Uses Readily Available Standard Inductors
- Create a Custom Design with WEBENCH Tools
- Thermal Shutdown and Current Limit Protection

2 Applications

- Simple High-Efficiency Step-Down (Buck) Regulator
- Efficient Preregulator for Linear Regulators
- On-Card Switching Regulators
- Positive-to-Negative Converter (Buck-Boost)

3 Description

The LM2576 series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, 15 V, and an adjustable output version.

Requiring a minimum number of external components, these regulators are simple to use and include fault protection and a fixed-frequency oscillator.

The LM2576 series offers a high-efficiency replacement for popular three-terminal linear regulators. It substantially reduces the size of the heat sink, and in some cases no heat sink is required.

A standard series of inductors optimized for use with the LM2576 are available from several different manufacturers. This feature greatly simplifies the design of switch-mode power supplies.

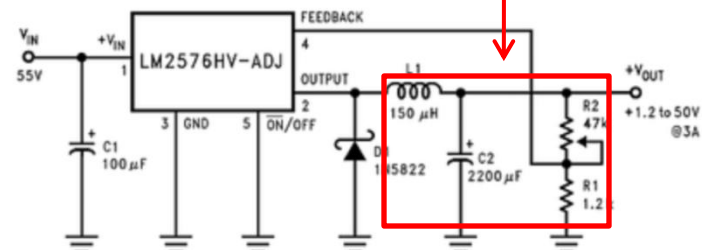
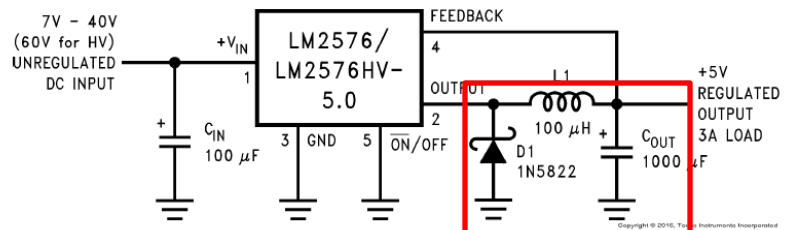
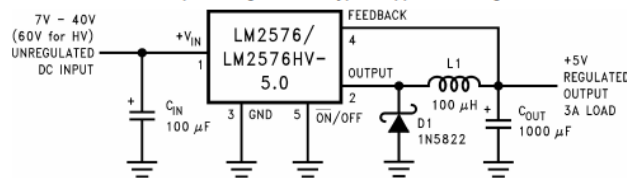
Other features include a $\pm 4\%$ tolerance on output voltage within specified input voltages and output load conditions, and $\pm 10\%$ on the oscillator frequency. External shutdown is included, featuring 50- μ A (typical) standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown for full protection under fault conditions.

Device Information⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LM2576	TO-220 (5)	10.16 mm \times 8.51 mm
LM2576HV	DDPAK/TO-263 (5)	10.16 mm \times 8.42 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

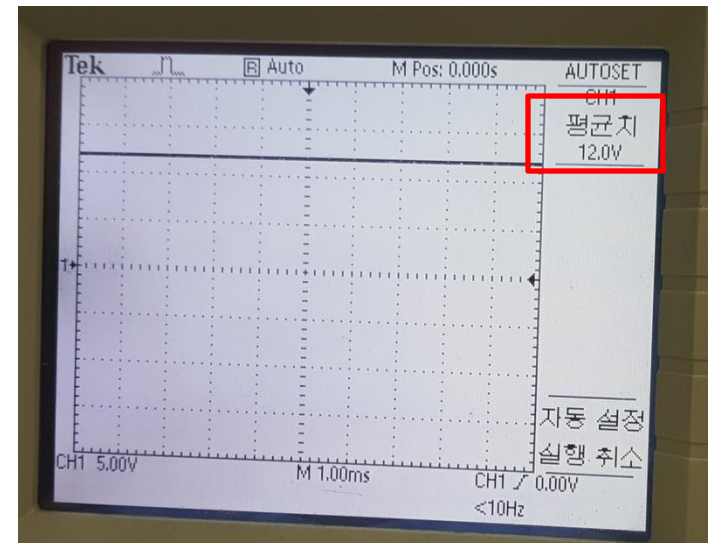
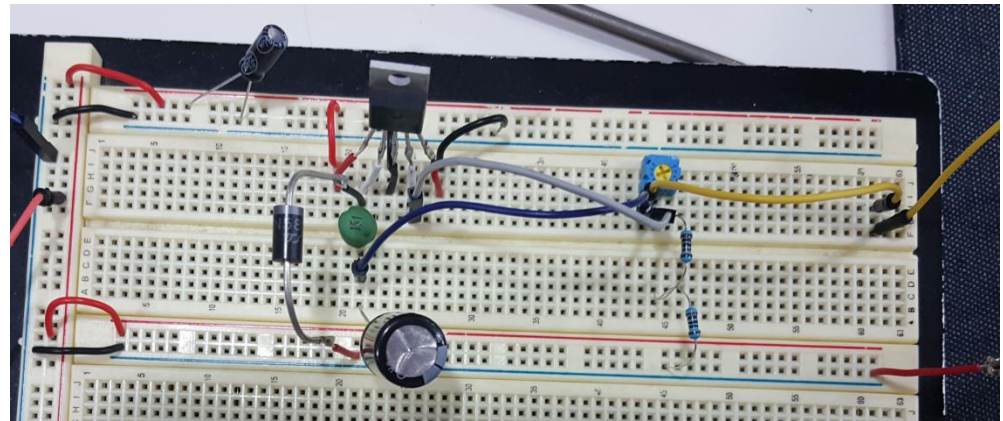
Fixed Output Voltage Version Typical Application Diagram



Bill Of Materials (Simple)

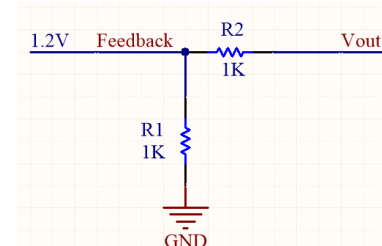
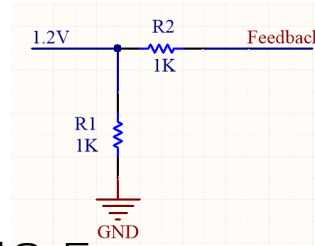
A	B	C	D	E	F
순번	명칭	개수	Package	URL	가격
1	LM2596T-ADJ	1	TO-220-5	http://m.eleparts.co.kr/goods/view?no=52686	₩ 7,420
2	AL-CAP 2200uF 16V 105도	1	Radial	http://m.eleparts.co.kr/goods/view?no=3369512	₩ 280
3	CAP ALUM 100uF 20% 25V 105도	1	Radial	http://m.eleparts.co.kr/goods/view?no=1037437	₩ 391
4	DIODE, 1N5822, SCHOTTKY, 3A, 40V	1	DO-201	http://m.eleparts.co.kr/goods/view?no=638020	₩ 564
5	INDUCTOR, 150UH, 0.28A, 10%	1	Radial	http://m.eleparts.co.kr/goods/view?no=2953968	₩ 386
6	CT-6P 50kΩ Square Trimming Potentiometer	1	Radial	http://m.eleparts.co.kr/goods/view?no=12660	₩ 320
7	Res Metal Film 1K Ohm 1% 0.25W(1/4W)	1		http://m.eleparts.co.kr/goods/view?no=1059877	₩ 124
8	Res Metal Film 200 Ohm 1% 0.25W(1/4W)	1			

Operation Test



LM2576 Specification

가장 낮은 19.8V에서
12V출력이 나오도록 가변저항을 조절한다
리플이 0.1V 정도 나오는데
DSP는 허용 리플이 0.2V이므로 사용할 수 있을 듯



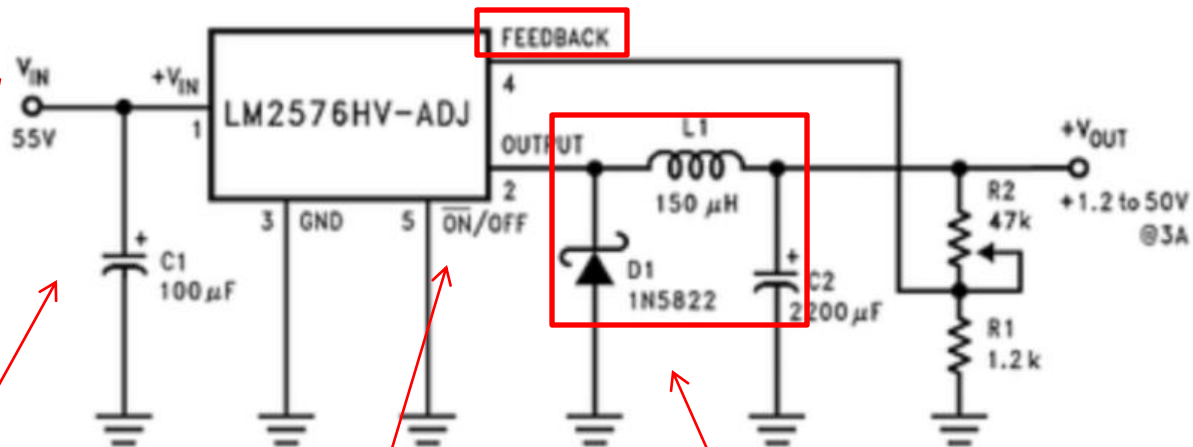
FB pin : 내부에 전압분배용 저항 2개 위치
(LM2576 adj는 외부에 저항 위치)

Up to 40V
(LM2576_HV : Up to 60V)

Bypass Capacitor
(for Filtering)

Regulator On all the time

Switch Regulator 약 50kHz로 동작
(IC 내부 오실레이터에 의한)



Altium Design Procedure – Integrated Library

New Project

Project Types:

- PCB Project
- FPGA Project
- Core Project
- Embedded Project
- Integrated Library**
- Script Project

Project Templates:

<Default>

PREVIEW NOT AVAILABLE

Integrated Library 프로젝트를 생성하고
PCB Library와 Schematic Library를 추가

Name

Integrated_Library

Location

C:\Workspace\Altium\Projects

Browse Location...

☒ Create Project Folder

Repository

Manage Repositories...

☐ Add Project to Version Control

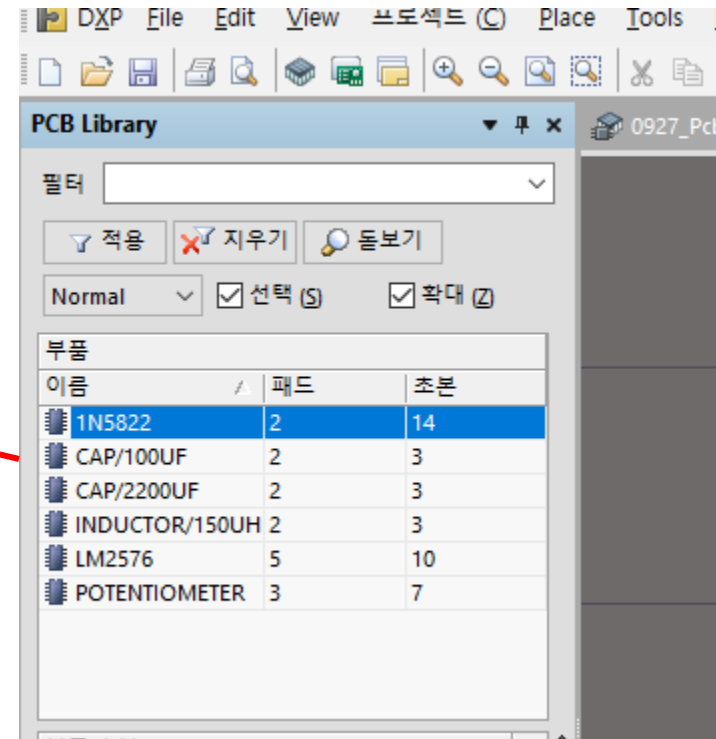
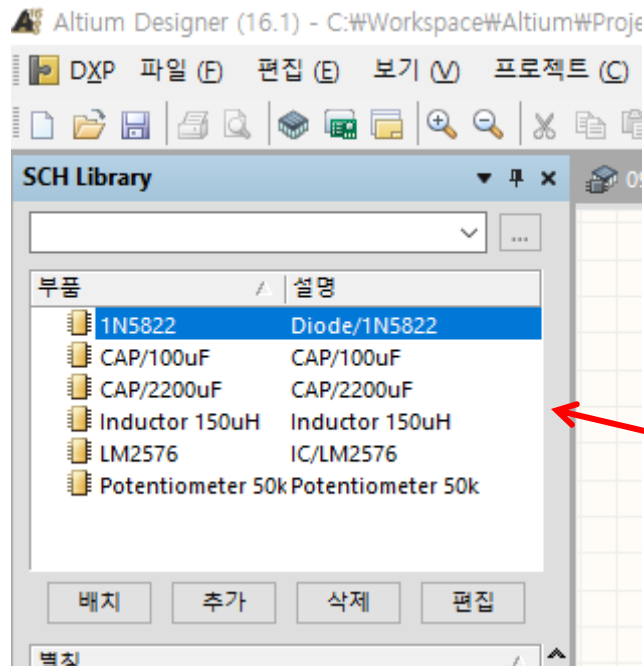
Repository Folder

Browse Folder...

☐ Managed Project

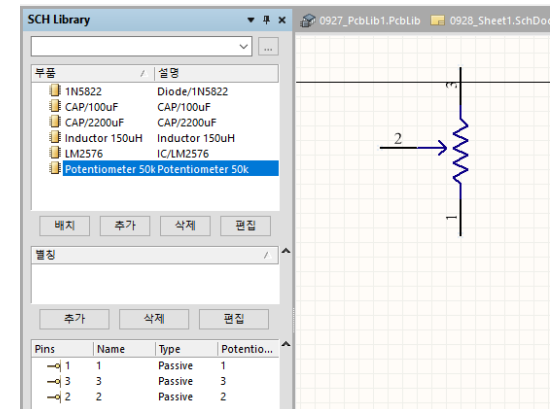
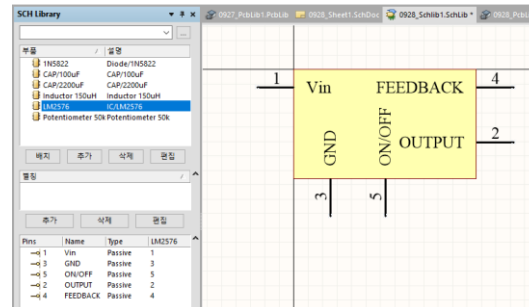
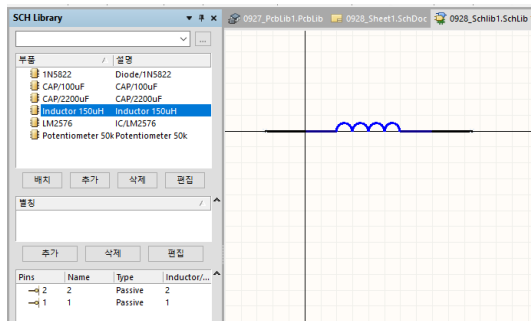
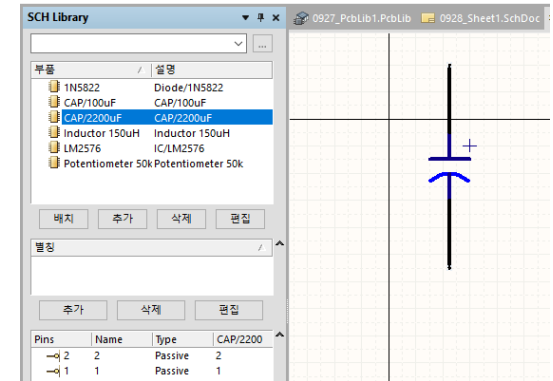
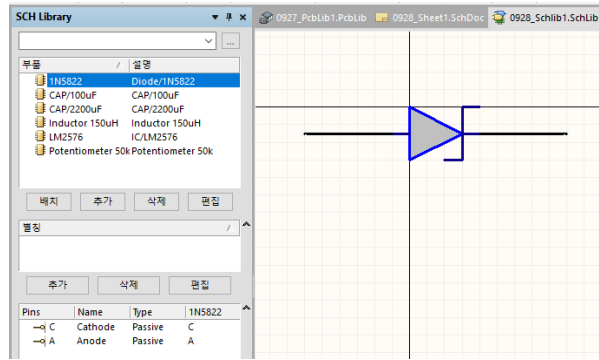
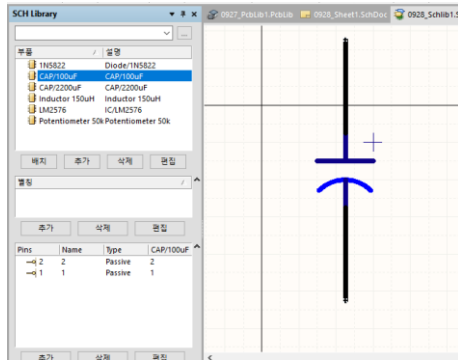
OK Cancel

Altium Design Procedure

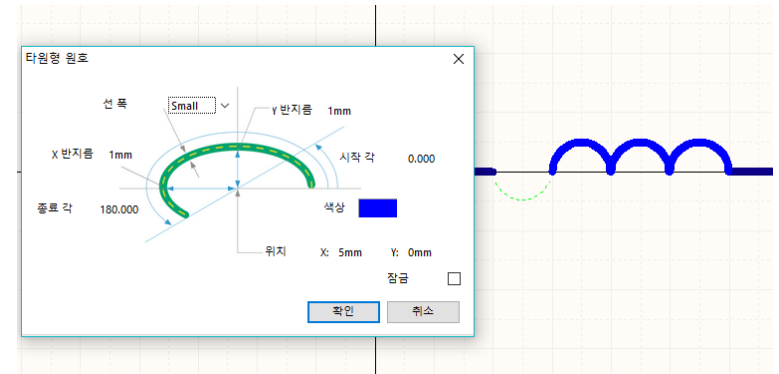
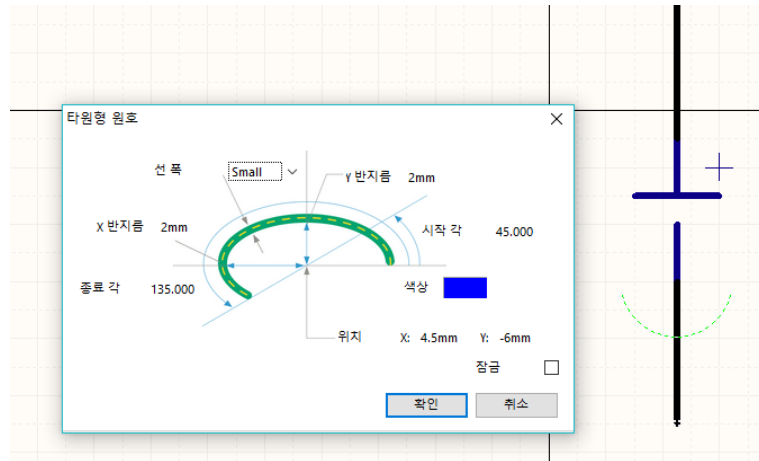


Schematic , PCB Footprint 작성하고 작성된 Schematic Library에 Add Footprint

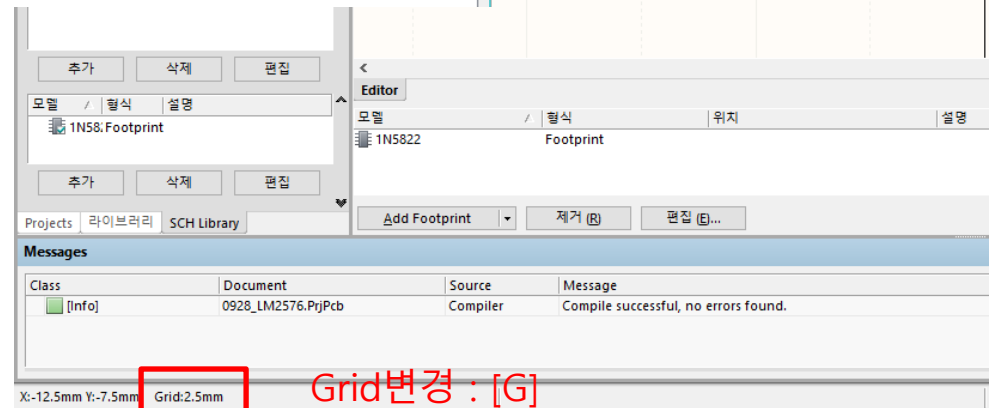
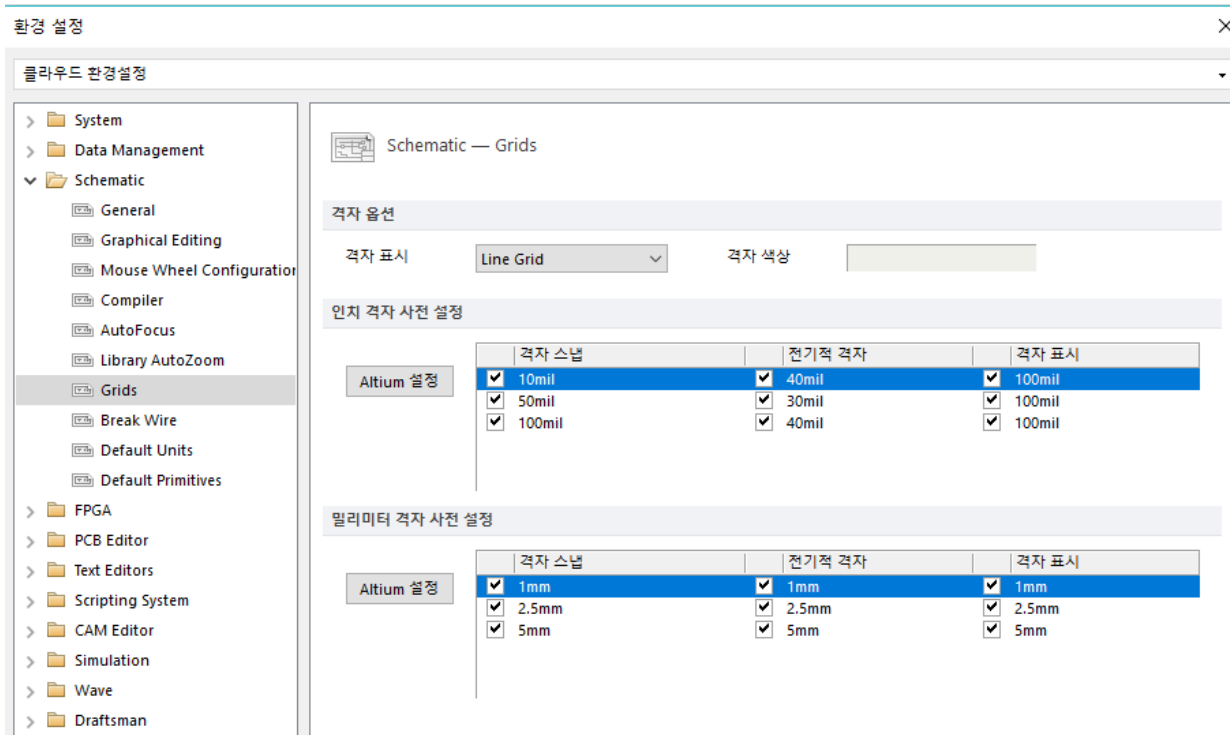
Altium Design Procedure - Schematic Library



(*) Altium Design Procedure - Eclipse



(*) Altium Design Procedure – Change Grid



Grid변경 : [G]

Altium Design Procedure

부품 설계 참조 번호
부품 기호 및 값

상세 설명

Symbol 이름

Library Component Properties

Properties

Default Designator	<input type="text" value="D1"/>	<input checked="" type="checkbox"/> Visible	<input type="checkbox"/> Locked
Default Comment	<input type="text" value="Diode/1N5822"/>	<input checked="" type="checkbox"/> Visible	
	<input >="" ><="" <input="" td="" type="button" value=" >> "/> <td>Part 1/1</td> <td><input checked="" type="checkbox"/> Locked</td>	Part 1/1	<input checked="" type="checkbox"/> Locked
Description	<input type="text" value="Diode/1N5822"/>		
Type	<input type="text" value="Standard"/>		

Library Link

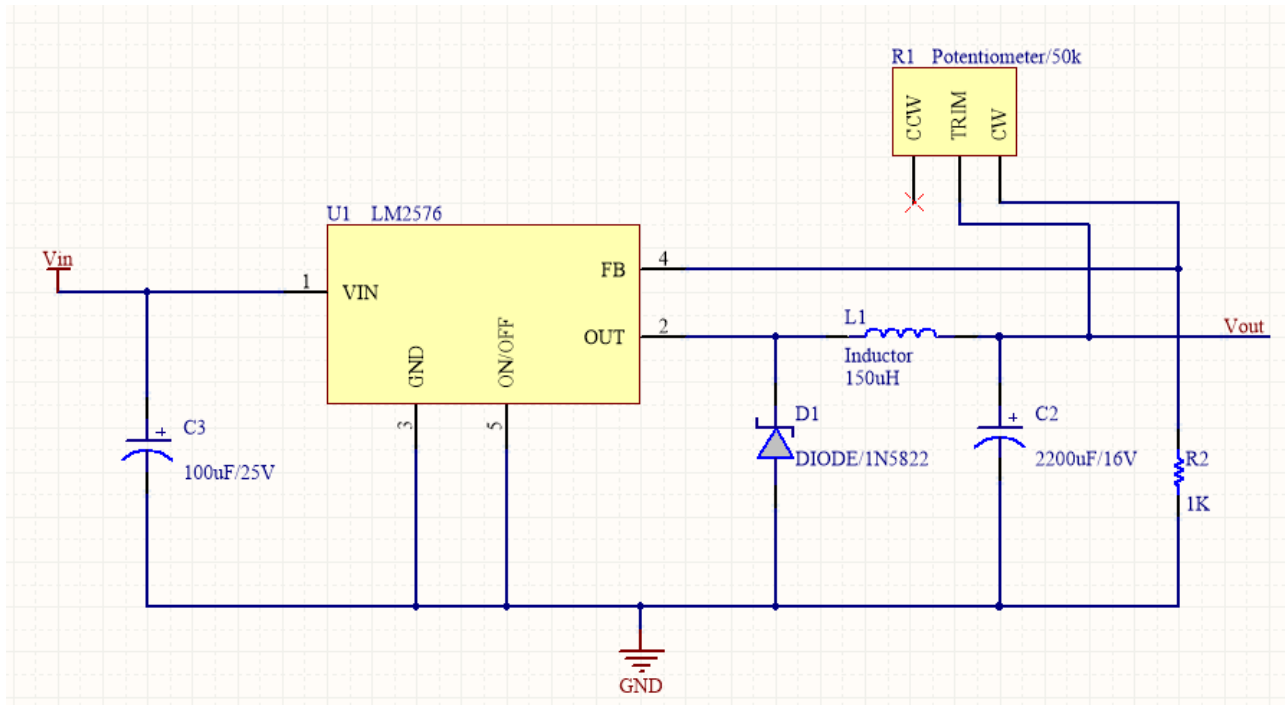
Symbol Reference	<input type="text" value="1N5822"/>
------------------	-------------------------------------

Graphical

Mode	<input type="text" value="Normal"/>	<input checked="" type="checkbox"/> Lock Pins
<input type="checkbox"/> Show All Pins On Sheet (Even if Hidden)		
<input type="checkbox"/> Local Colors		

Altium Design Procedure - New PCB Project (Schdoc)

Schematic.doc → Compile, Message 확인

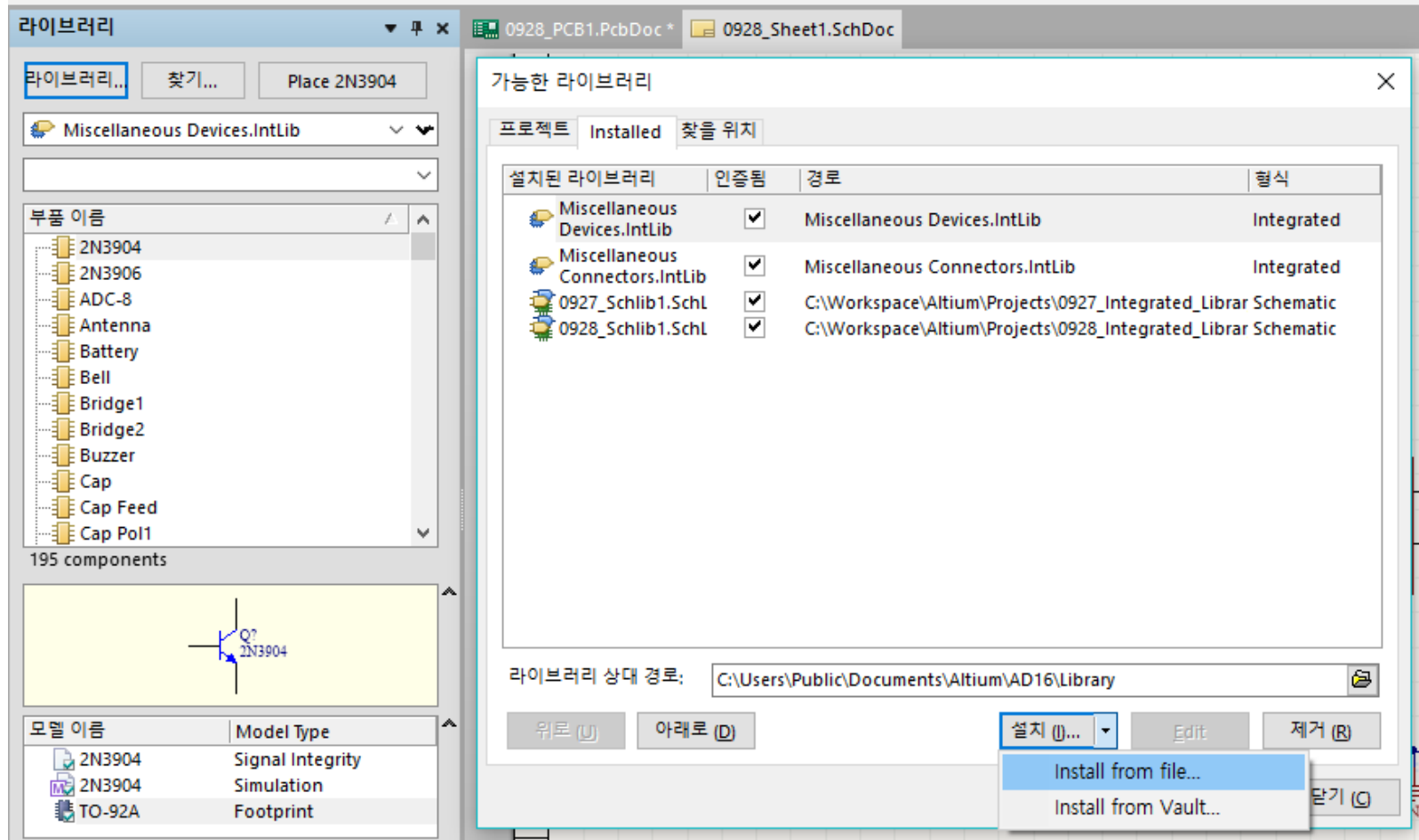


Messages

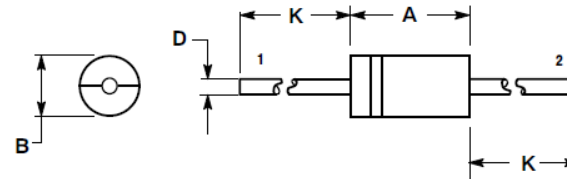
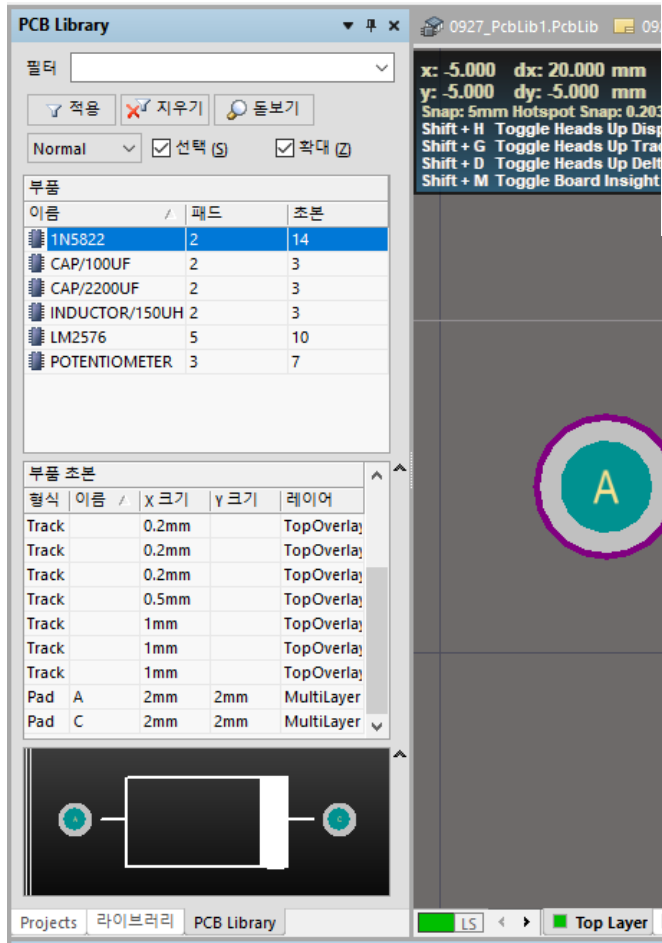
Class	Document	Source	Message
[Info]	0928_LM2576.PrjPcb	Compiler	Compile successful, no errors found.

Altium Design Procedure

Integrated Library 추가



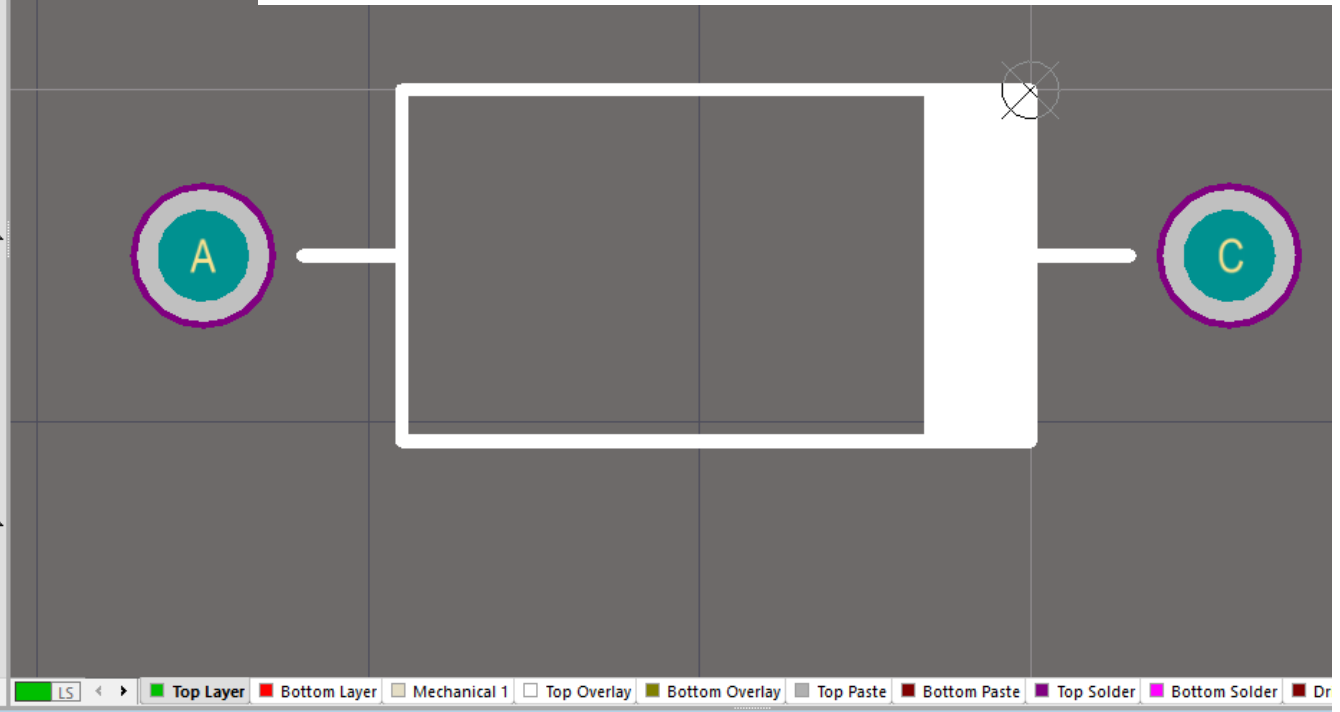
Altium Design Procedure – PCB Library



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.287	0.374	7.30	9.50
B	0.189	0.209	4.80	5.30
D	0.047	0.051	1.20	1.30
K	1.000	---	25.40	---

- STYLE 1:
- PIN 1: CATHODE (POLARITY BAND)
 - ANODE



Altium Design Procedure

PCB Library

필터

적용 지우기 돋보기

Normal 선택 확대

부품

이름	패드	초본
1N5822	2	14
CAP/100UF	2	3
CAP/2200UF	2	3
INDUCTOR/150UH	2	3
LM2576	5	10
POTENTIOMETER	3	7

부품 초본

형식	이름	X 크기	Y 크기	레이어
Arc		0.15mm		TopOverlay
Pad	1	1mm	1mm	MultiLayer
Pad	2	1mm	1mm	MultiLayer

0927_PcbLib1.PcbLib 0928_Sheet1.SchDoc 0928_SchLib1.SchLib * 0928_PcbLib1.PcbLib 0928_PCB1.PcbDoc * 0928_Job

DIMENSIONS OF KMG Series

Unit (mm)

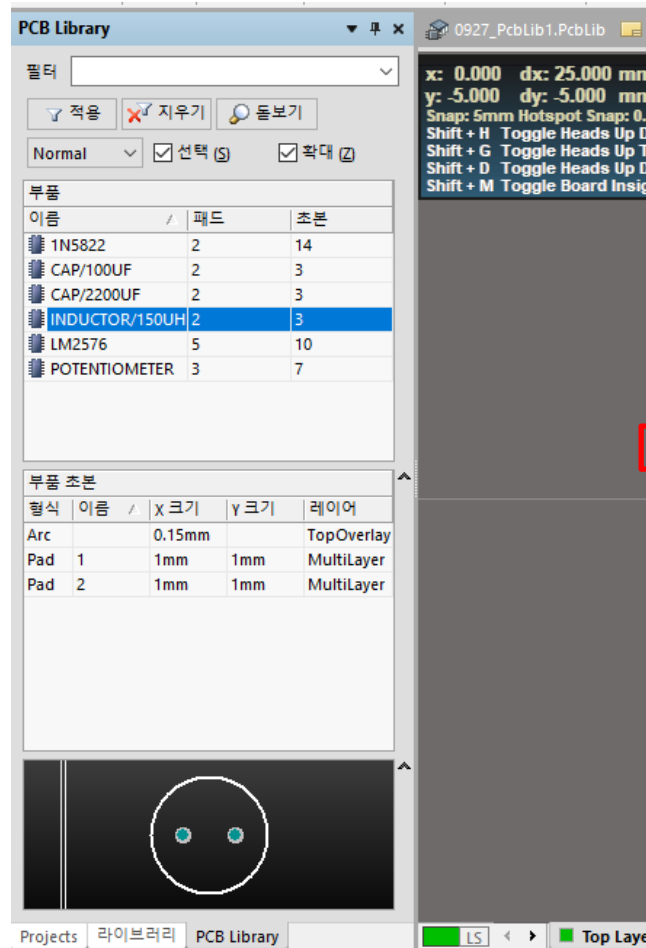
Marking : BROWN SLEEVE , WHITE INK

φD	5	6.3	8	10	12.5	16	18
φd	0.5	0.5	0.6	0.6	0.6	0.8	0.8
F	2.0	2.5	3.5	5.0	5.0	7.5	7.5
φD	φD + 0.5 max.						
L'	L + 1.5 max.				L + 2 max.		

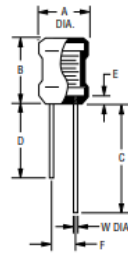
Projects 라이브러리 PCB Library

LS Top Layer Bottom Layer Mechanical 1 Top Overlay Bottom Overlay Top Paste Bottom Paste Top

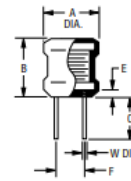
Altium Design Procedure



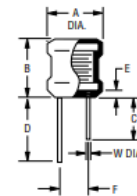
RLB0608, RLB0812, RLB1014, RLB0712, RLB0914 Series



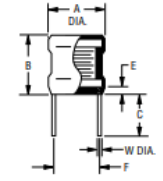
RLB0912 Series



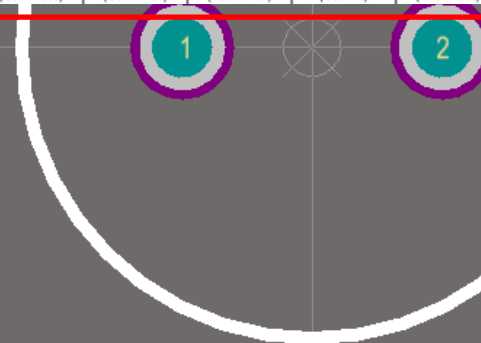
RLB1314-680K through RLB1314-153K



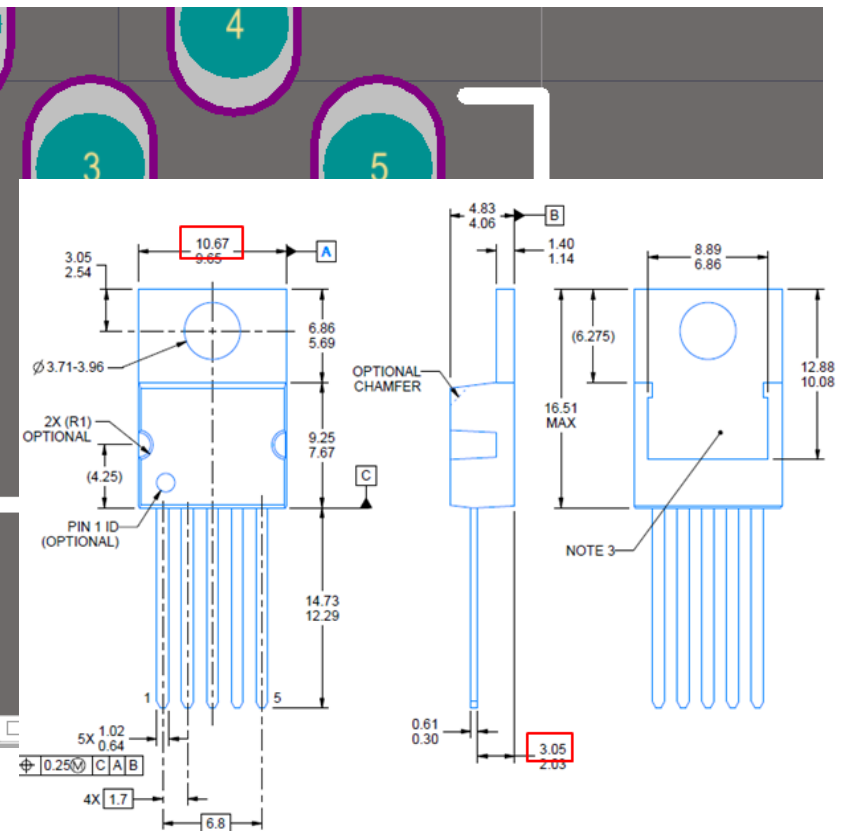
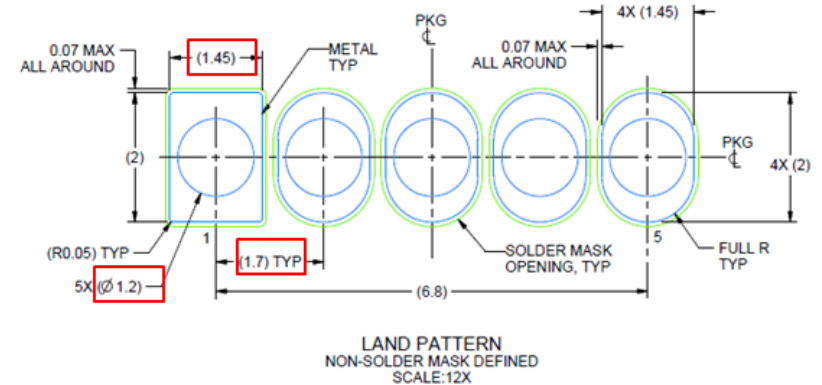
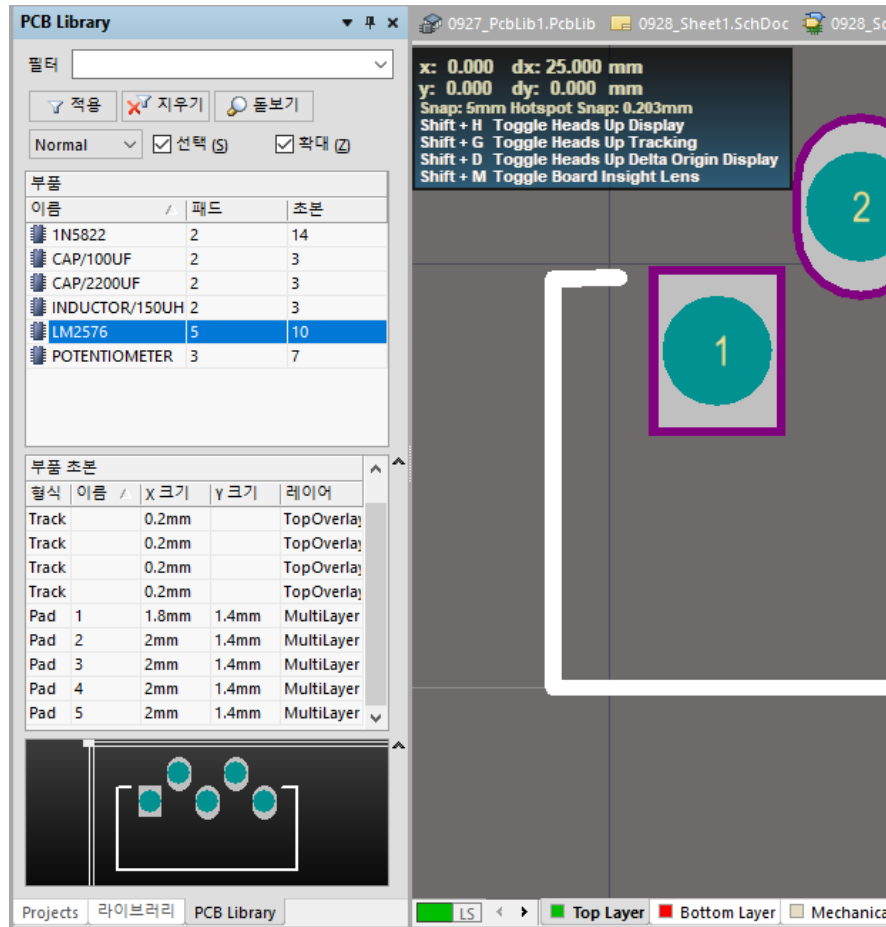
RLB1314-3R3M through RLB1314-470K



Series	A	B	C	D	E	F	W (DIA.)	Inductance Range
RLB0608	5.0 ± 0.5 (.197 ± .020)	6.5 ± 1.0 / 0.5 (.256 ± .039 / .020)	28.0 ± 5.0 (1.102 ± .197)	20.0 ± 5.0 (.787 ± .197)	2.5 ± 0 (.098 ± 0)	2.0 ± 0.5 (.079 ± .020)	0.50 (.020)	1.0 µH - 2200 µH
RLB0812	6.7 ± 0.5 (.264 ± .020)	10.0 ± 1.0 (.394 ± .039)	25.0 ± 5.0 (.984 ± .197)	18.0 ± 5.0 (.709 ± .197)	2.5 ± 0 (.098 ± 0)	3.0 ± 0.5 (.118 ± .020)	0.65 (.026)	47 µH - 47 mH
RLB1014	8.7 ± 0.5 (.343 ± .020)	12.0 ± 1.0 (.472 ± .039)	25.0 ± 5.0 (.984 ± .197)	18.0 ± 5.0 (.709 ± .197)	2.5 ± 0 (.098 ± 0)	5.0 ± 0.8 (.197 ± .031)	0.65 (.026)	100 µH - 82 mH
RLB0712	6.7 ± 0.5 (.264 ± .020)	10.0 ± 1.0 (.394 ± .039)	25.0 ± 5.0 (.984 ± .197)	18.0 ± 5.0 (.709 ± .197)	2.5 ± 0 (.098 ± 0)	3.0 ± 0.5 (.118 ± .020)	0.65 (.026)	10 µH - 560 µH



Altium Design Procedure



Altium Design Procedure

PCB Library

필터

적용 지우기 돌보기

Normal 선택 확대

부품

이름	패드	초본
1N5822	2	14
CAP/100UF	2	3
CAP/2200UF	2	3
INDUCTOR/150UH	2	3
LM2576	5	10
POTENTIOMETER	3	7

부품 초본

형식	이름	x 크기	y 크기	레이어
Arc		0.15mm		TopOverlay
Pad	1	1mm	1mm	MultiLayer
Pad	2	1mm	1mm	MultiLayer

SIDE VIEW

TERMINAL END VIEW

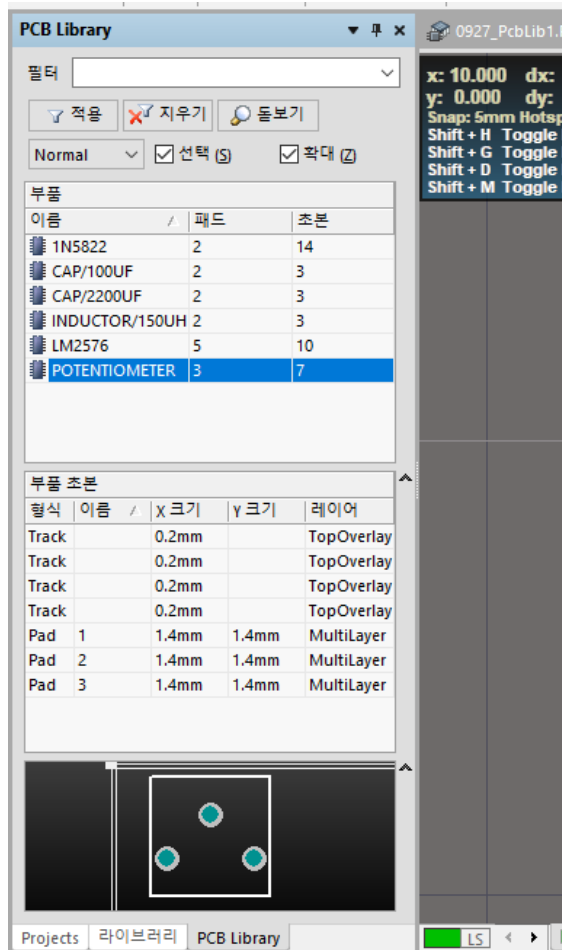
Size Code	D		L		p		d		LL+/LL-	
	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance
C3	5	±0.5	11	+1.5/-0	2	±0.5	0.5	Nominal	20/15	Minimum

Projects 라이브러리 PCB Library

Top Layer Bottom Layer Mechanical 1 Top Overlay Bottom Overlay Top Paste Bottom Paste

Altium Design Procedure

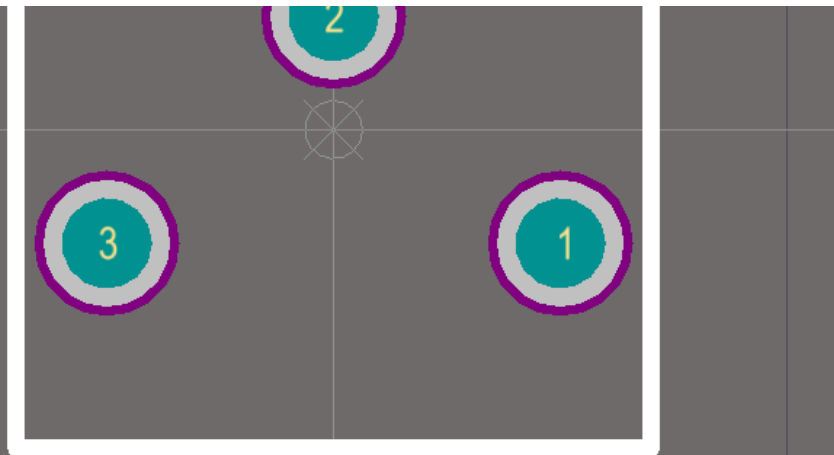
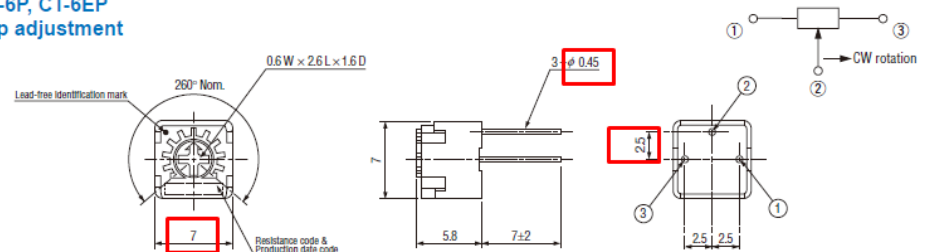
CT-6 CERMET TRIMMERS



OUTLINE DIMENSIONS

- CT-6P, CT-6EP
Top adjustment

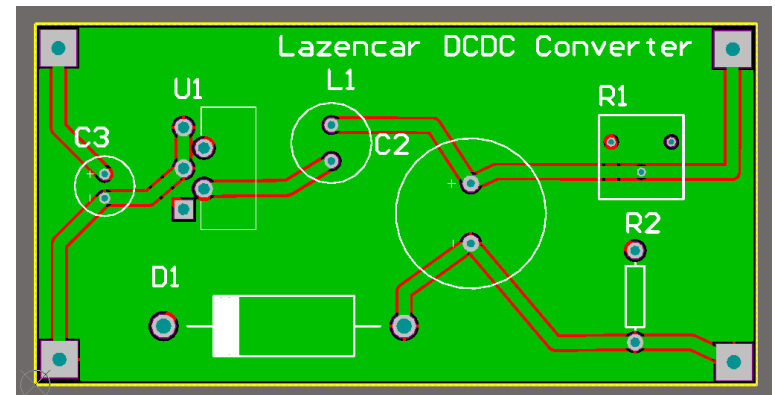
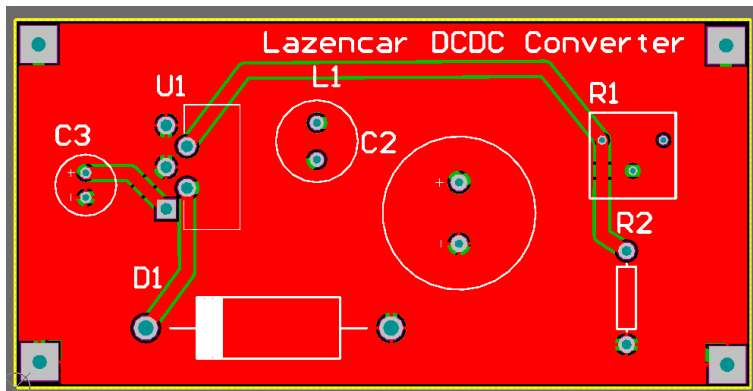
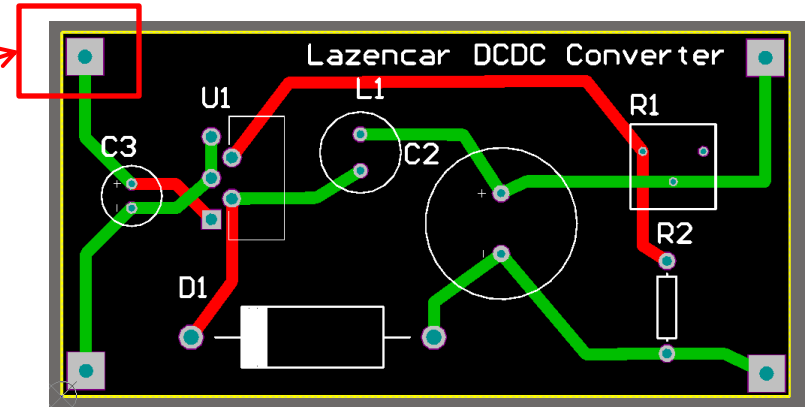
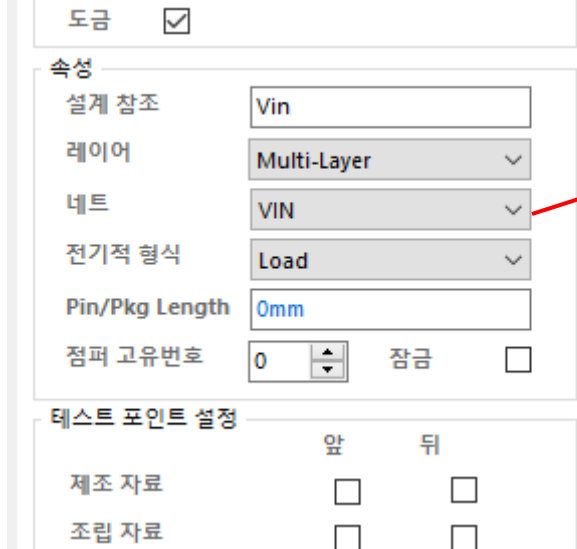
Unless otherwise specified, tolerance: ± 0.3 (Unit: mm)



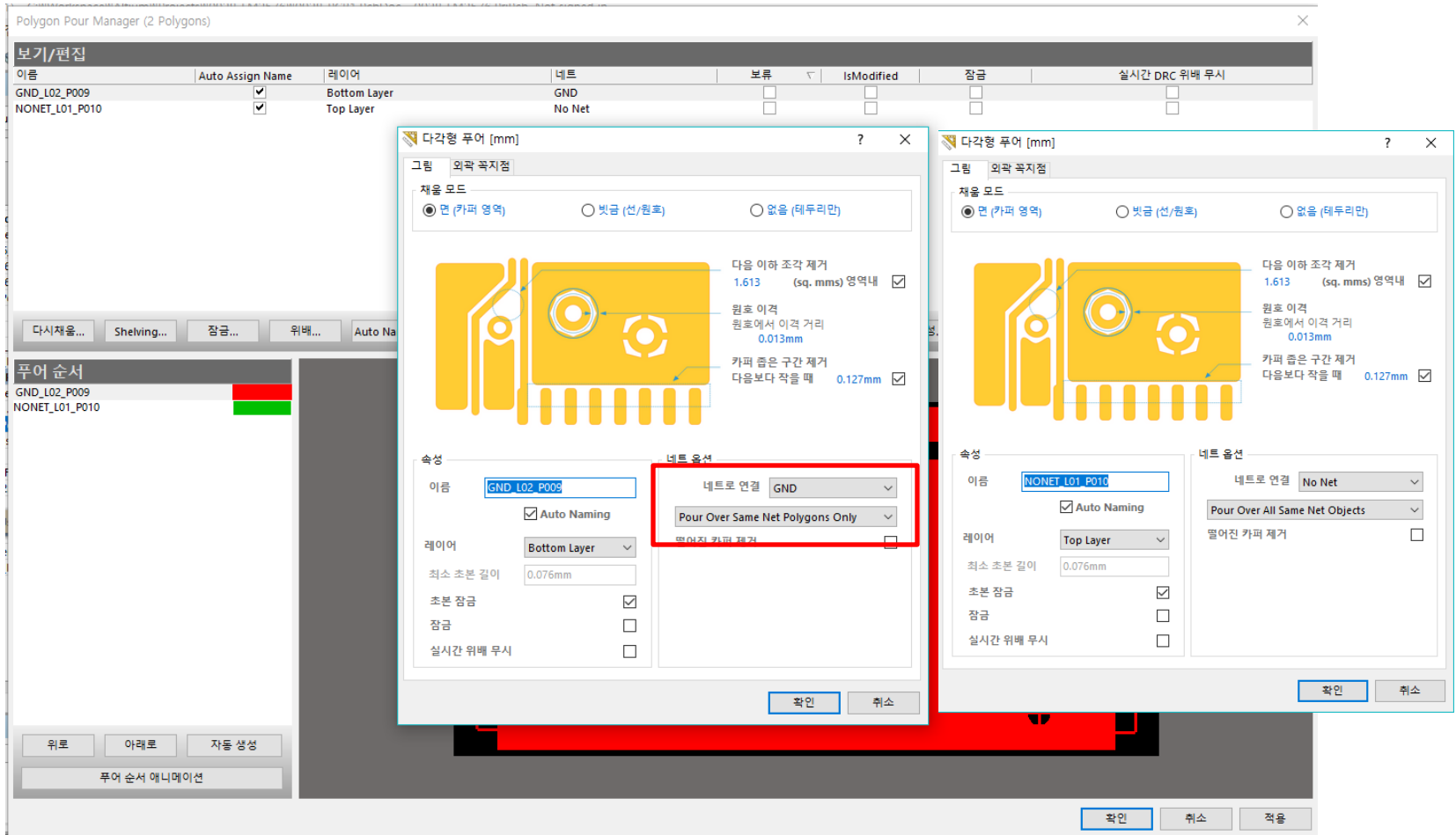
Projects 라이브러리 PCB Library Top Layer Bottom Layer Mechanical 1 Top Overlay Bottom Overlay Top Paste Bottom Paste

Altium Design Procedure - New PCB Project (PCBdoc)


Update Schematics to PCB.doc → 설계 규칙 검사



Altium Design Procedure



Altium Design Procedure – 설계 규칙 검사

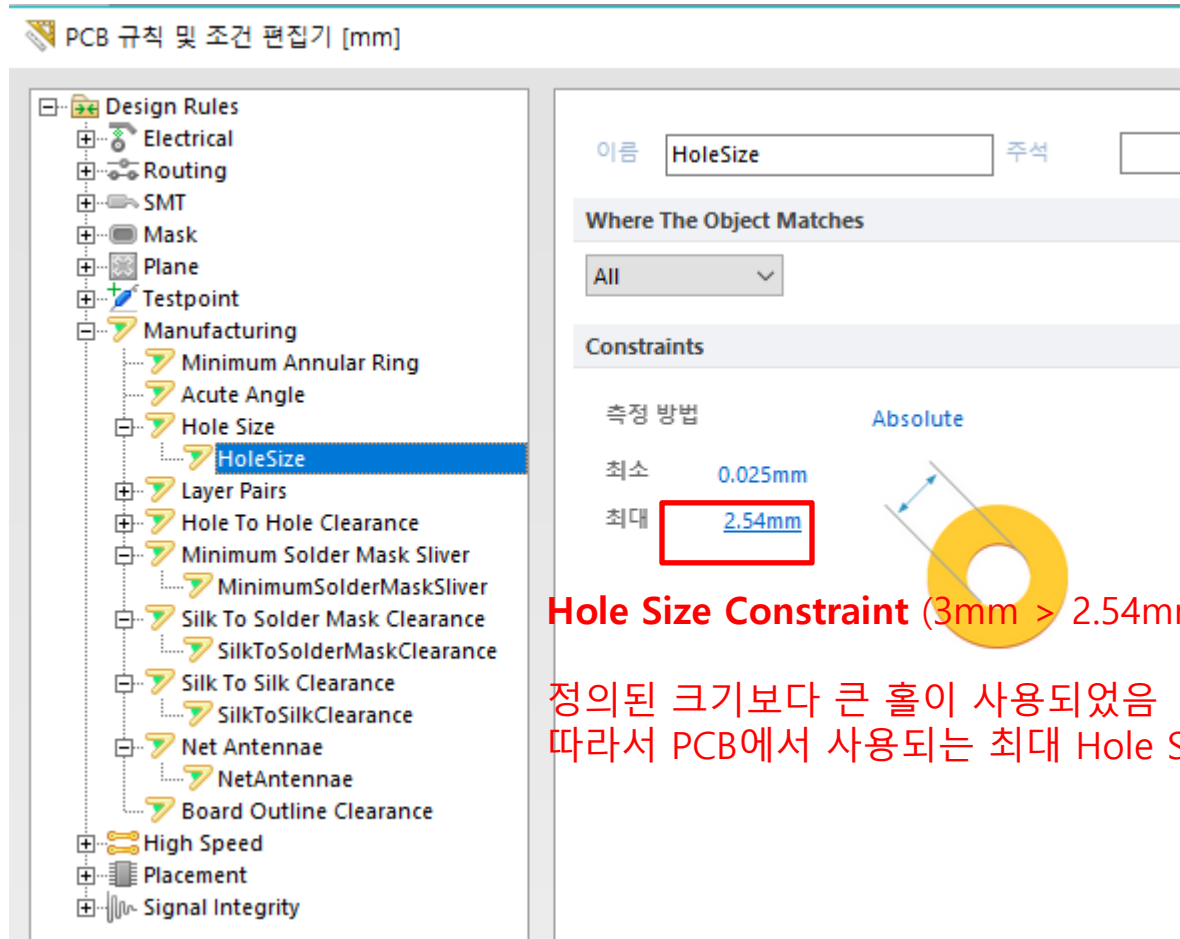


Design Rule Verification Report

Date:	2018-09-29	Warnings: 0 Rule Violations: 0
Time:	2018-09-29 9:08:47	
Elapsed Time:	00:00:00	
Filename:	C:\Workspace\Altium\Projects\0928_LM2576\0928_PCB1.PcbDoc	

Summary

Altium Design Procedure – 설계 규칙 검사



Altium Design Procedure – 설계 규칙 검사

PCB 규칙 및 조건 편집기 [mm]

Design Rules

- Electrical
- Routing
- SMT
- Mask
- Plane
- Testpoint
- Manufacturing
 - Minimum Annular Ring
 - Acute Angle
 - Hole Size
 - HoleSize
 - Layer Pairs
 - Hole To Hole Clearance
 - Minimum Solder Mask Sliver
 - MinimumSolderMaskSliver
 - Silk To Solder Mask Clearance
 - SilkToSolderMaskClearance**
 - Silk To Silk Clearance
 - SilkToSilkClearance
 - Net Antennae
 - NetAntennae
 - Board Outline Clearance
- High Speed
- Placement
- Signal Integrity

이름: SilkToSolderMaskClearance 주석: 고유 인식 번호: NRVUQCGO Test Queries

Where The First Object Matches

Custom Query: IsPad

질문 도우미 ...

질문 제작 ...

Where The Second Object Matches

All

Constraints


Clearance Checking Mode

- ☒ Check Clearance To Exposed Copper
- ☐ Check Clearance To Solder Mask Openings

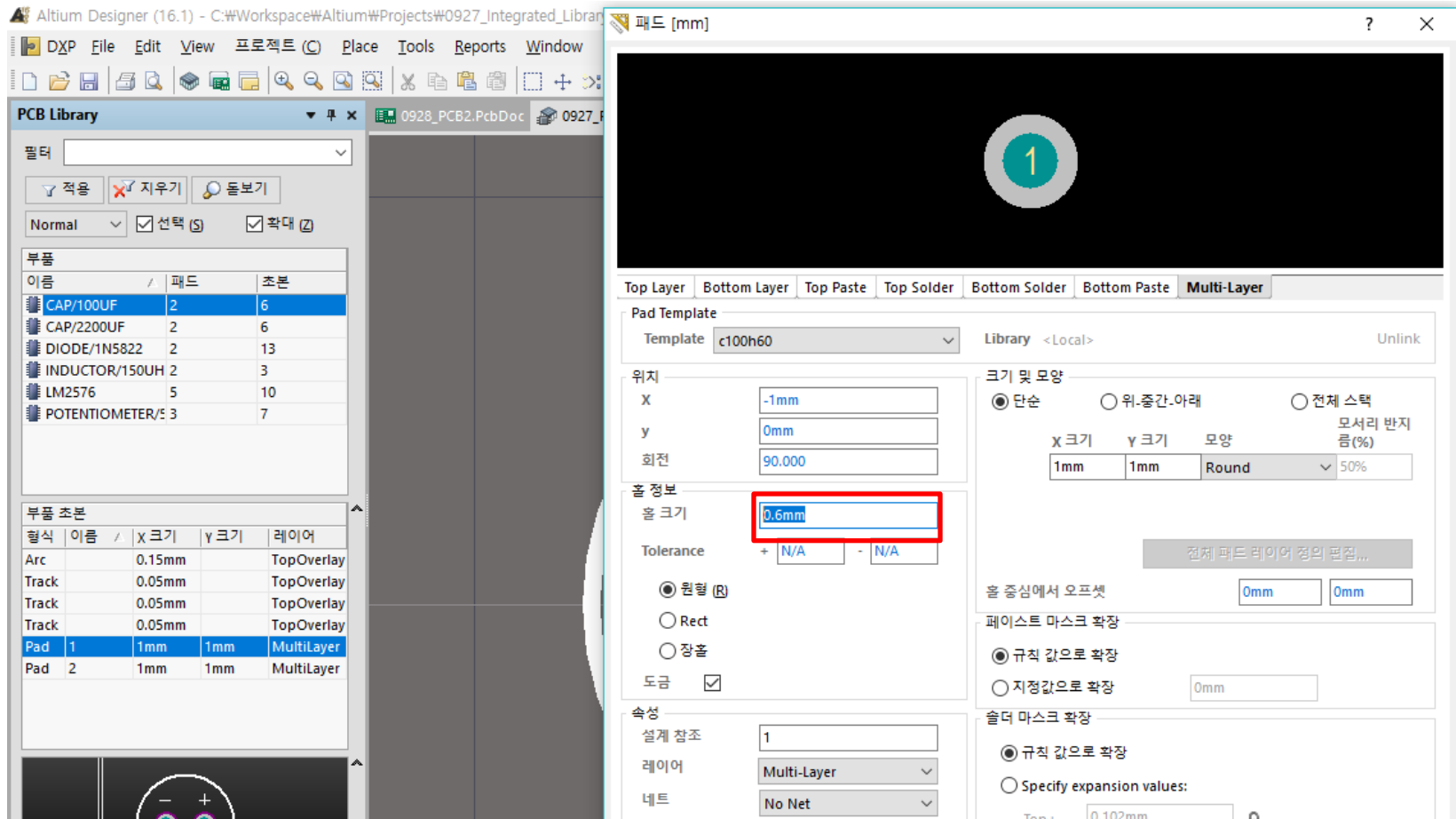
Silkscreen To Object Minimum Clearance: 0.051mm

Silk To Silk Clearance Constraint (0.163mm < 0.254mm)

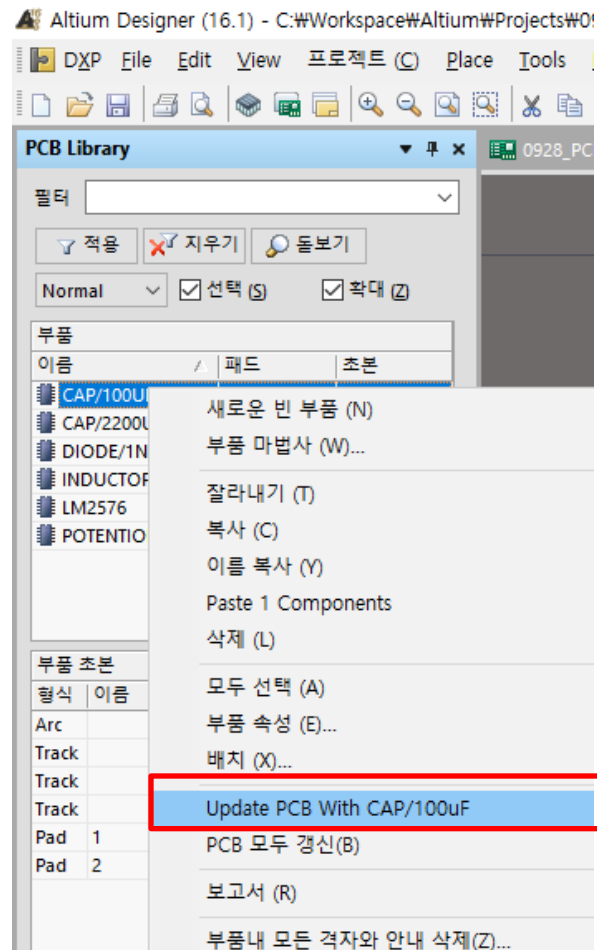
대상과 실크 이격거리가 지정된 값보다 크다
따라서 Minimum Clearance 변경 → 3mil



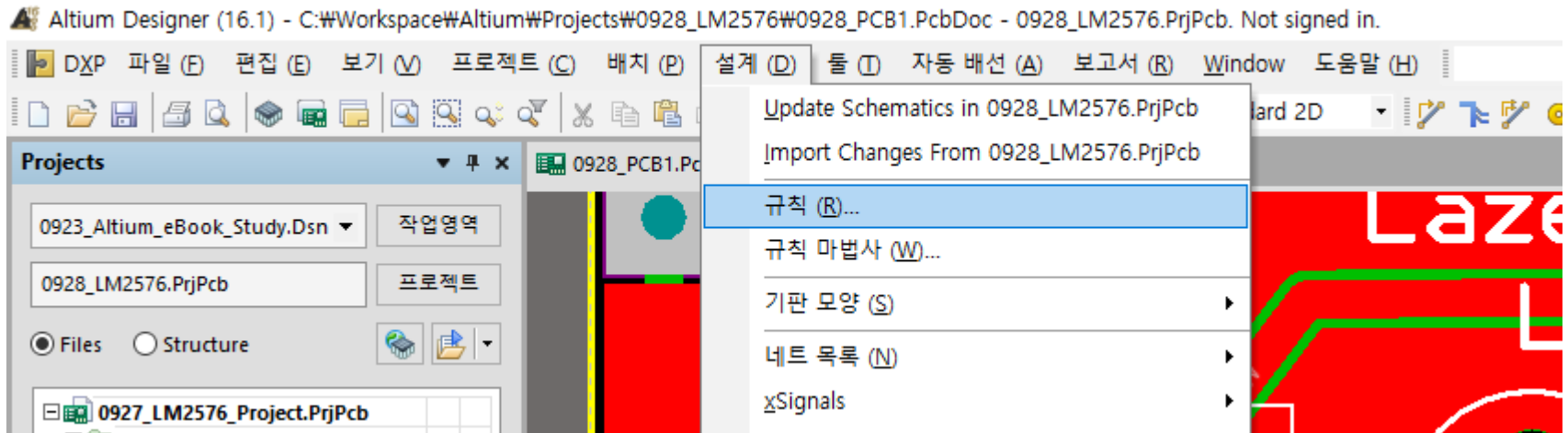
(*) Altium Design Procedure - PCB 라이브러리 갱신



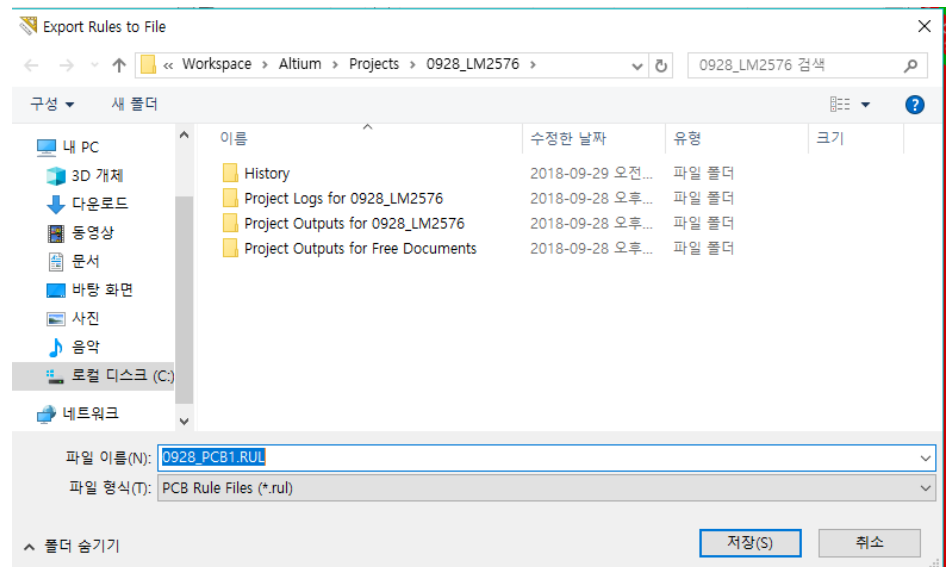
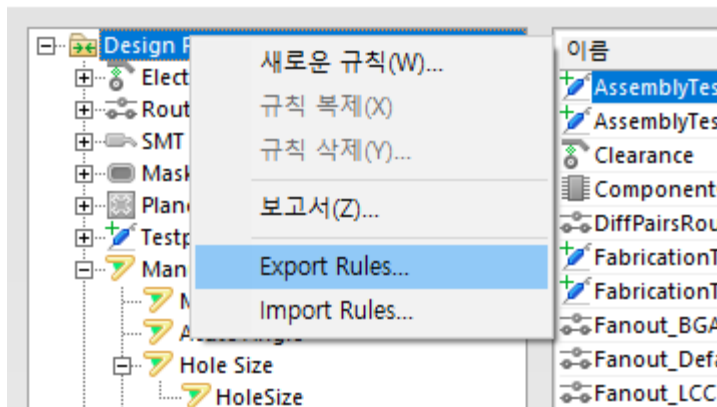
Altium Design Procedure



(*) Altium Design Procedure – 설계규칙 Export

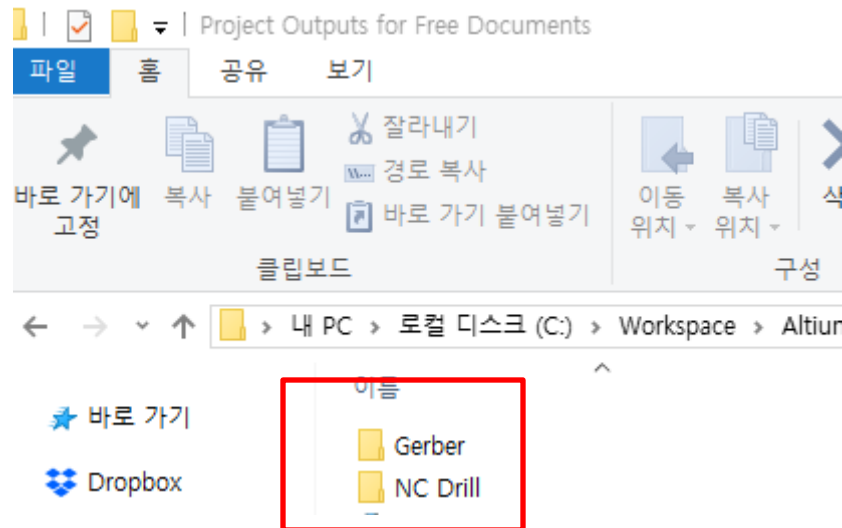
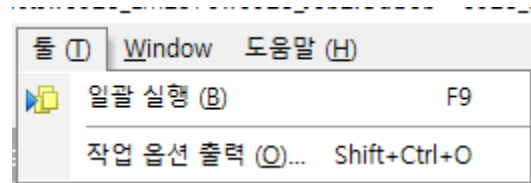


PCB 규칙 및 조건 편집기 [mm]



Altium Design Procedure - New PCB Project (Output Job)

Output Job File 생성 → 작업옵션 설정 → 일괄실행



PCB 발주

No. 1/1						견 적 서													
날짜: 2018 년 09 월 28 일						<div style="display: flex; align-items: center;"> <div style="writing-mode: vertical-rl; text-orientation: upright; margin-right: 5px;">공 급 자</div> <table border="1"> <tr> <td>상 호</td> <td>(주)한샘디지털</td> </tr> <tr> <td>주 소</td> <td>인천시 서구 석남동 223-568</td> </tr> <tr> <td>사업자등록번호</td> <td>137 - 81 - 30130</td> </tr> <tr> <td>대표이사</td> <td>송 상 국</td> </tr> </table>  </div>						상 호	(주)한샘디지털	주 소	인천시 서구 석남동 223-568	사업자등록번호	137 - 81 - 30130	대표이사	송 상 국
상 호	(주)한샘디지털																		
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대표이사	송 상 국																		
수산: 정유경																			
참조: 정유경																			
아래와 같이 견적합니다.																			
합 계 금 액 (공급가액 + 세액)						일금 81,400원정													
품 명 및 규 격			수 량	단 가	공급가액	세 액	비 고												
PCB Project_Lazenc 060 x 030 1.6T 2L 2D			4	0	54,000	5,400													
필름 Project_Lazen 060 x 030 1.6T 2L 2D				0	20,000	2,000													
합 계					74,000	7,400													
<기타 참고 사항>																			
재 질	FR-4					*표면처리 HASL *형 커레 발주시 입금 후 발주서 또는 진 행요청(회신메일or팩스) 보내주시면 진행하 겠습니다. *공휴일, 일요일은 납기처서 제외됩니다. *구두발주는 불가능합니다. *현재 작업 보류중입니다.													
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