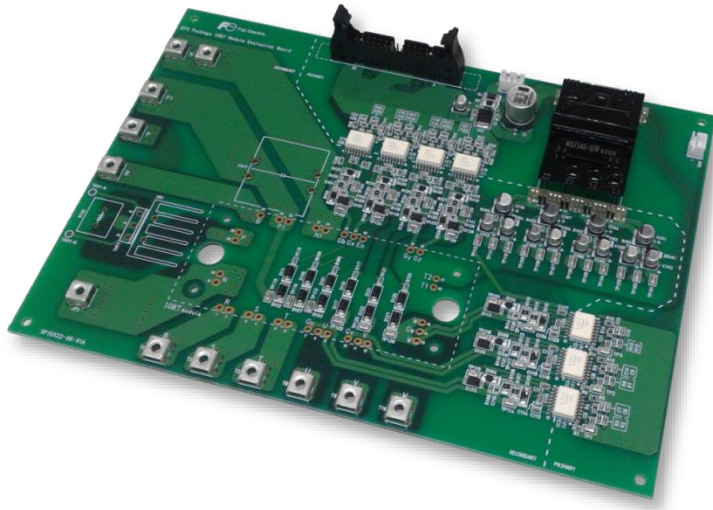
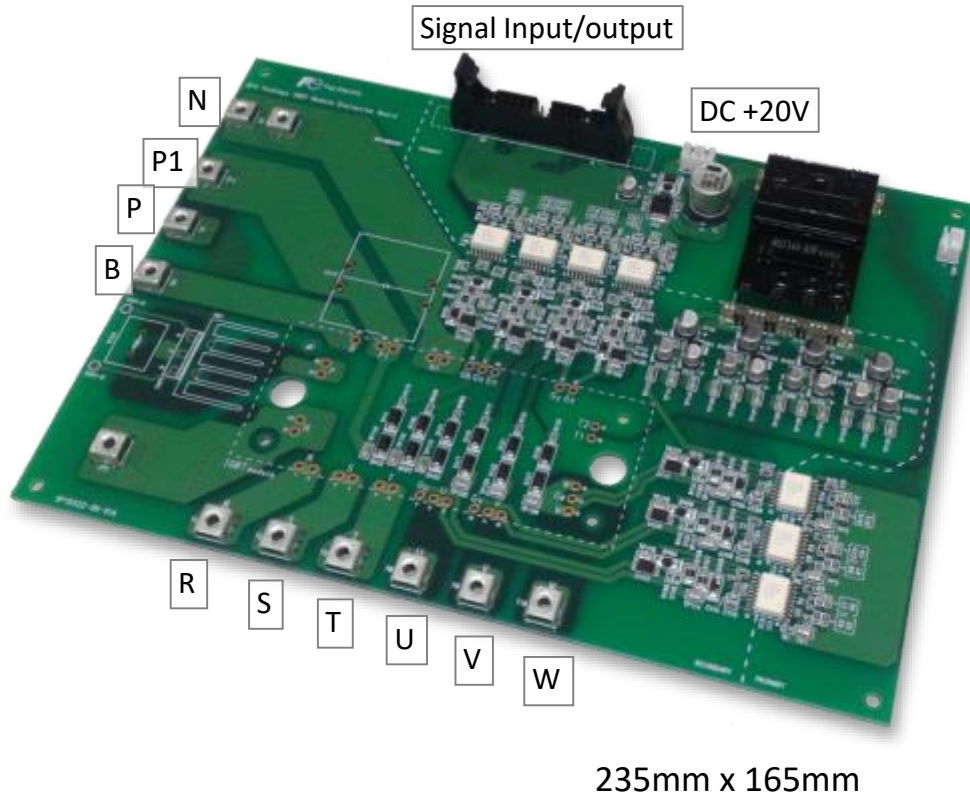


# FUJI IGBT Module EP2 Package Evaluation Board



September, 2022

Device Application Technology Dept.  
Sales Div., Electronic Devices Business Gr.  
Fuji Electric Co., Ltd.



- ✓ On-board isolated DC/DC power supply
- ✓ Broadcom (Avago) ACPL-337J driver IC  
Integrated fail-safe IGBT protection
  - Desaturation detection, “Soft” IGBT turn-off and fault feedback
  - Under Voltage Lock Out (UVLO) protection with feedback
- ✓ +5V CMOS level for PWM and fault signals
- ✓  $V_{GE} = +15V/-6V$  gate drive
- ✓ Support  $V_{GE} = +15V/0V$  gate drive (Option)
- ✓ We can provide the circuit diagram, PCB pattern, BOM to support your driver design

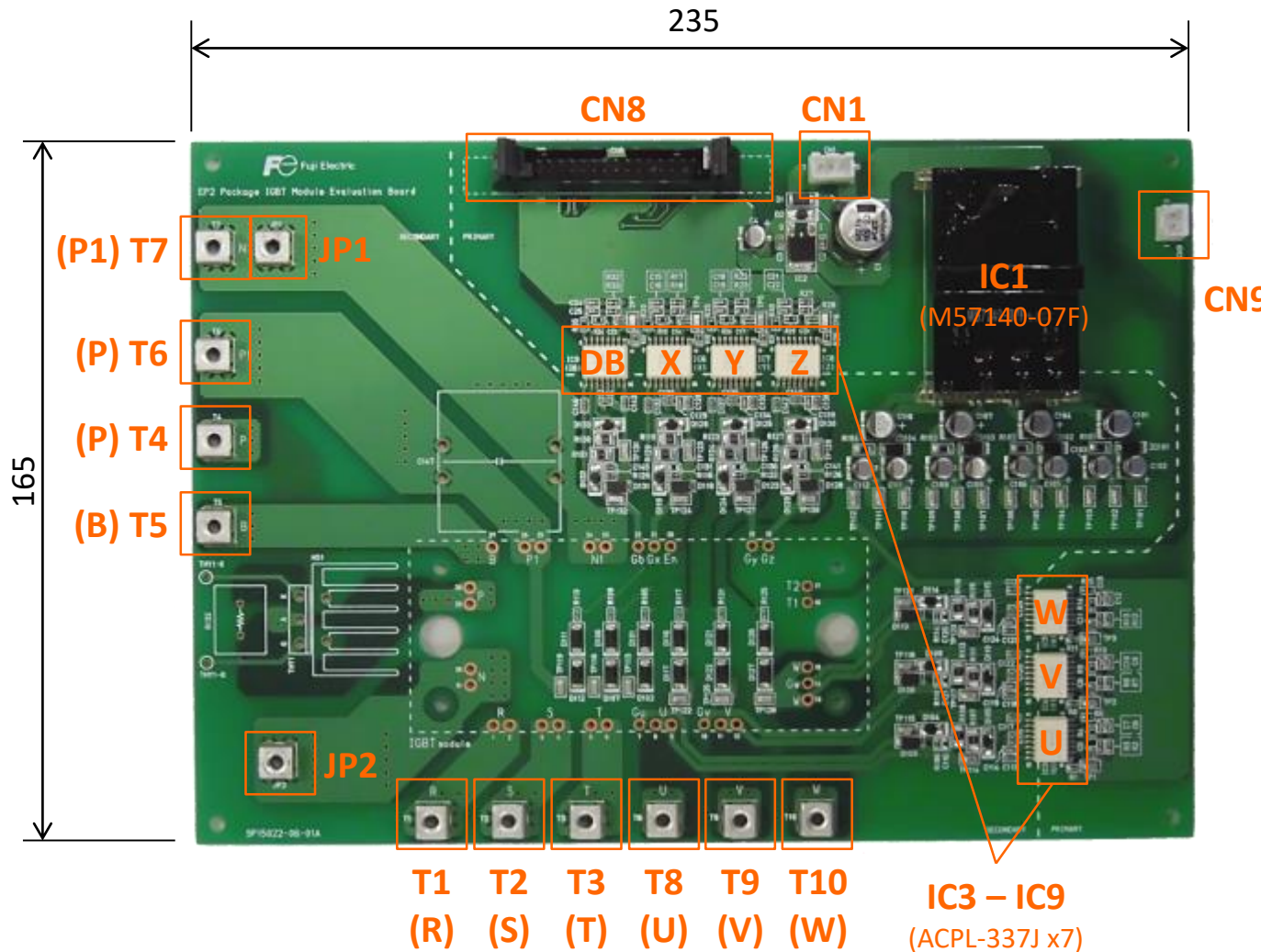
## Supported modules : EP2 solder pins (M719), “M” type module

(V series) 7MBR25VM120-50, 7MBR35VM120-50, 7MBR50VM120-50

(X series) 7MBR50XMA065-50, 7MBR75XMA065-50,

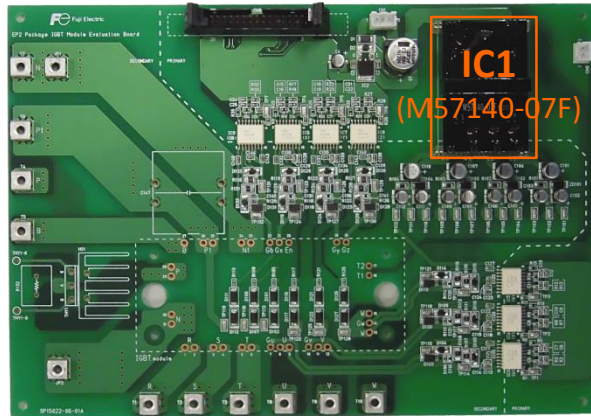
7MBR35XMA120-50, 7MBR50XMA120-50, 7MBR75XME120-50

# Layout of the Evaluation Board

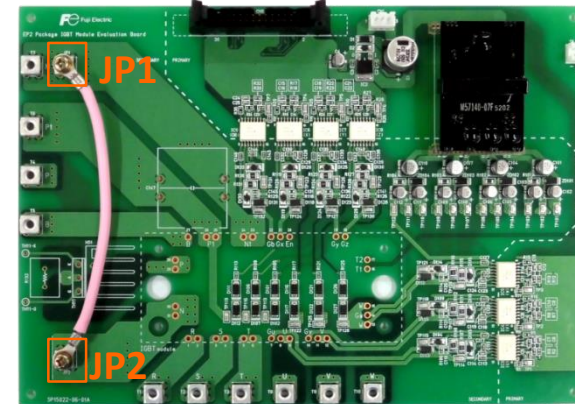


- IC1:** DC/DC power supply
- IC3 – IC9:** Gate driver IC  
ACPL-337J
- CN1:** Power supply connector  
(DC +20V)
- CN8:** Gate PWM signal input/  
Fault signal output
- CN9:** NTC output
- T1 – T3:** 3φ AC input terminal
- T5:** Brake terminal
- T4, T6:** DC+ terminal
- T7:** DC- terminal
- T8 – T10:** 3φ AC output terminal
- JP1, JP2:** Jumper connection

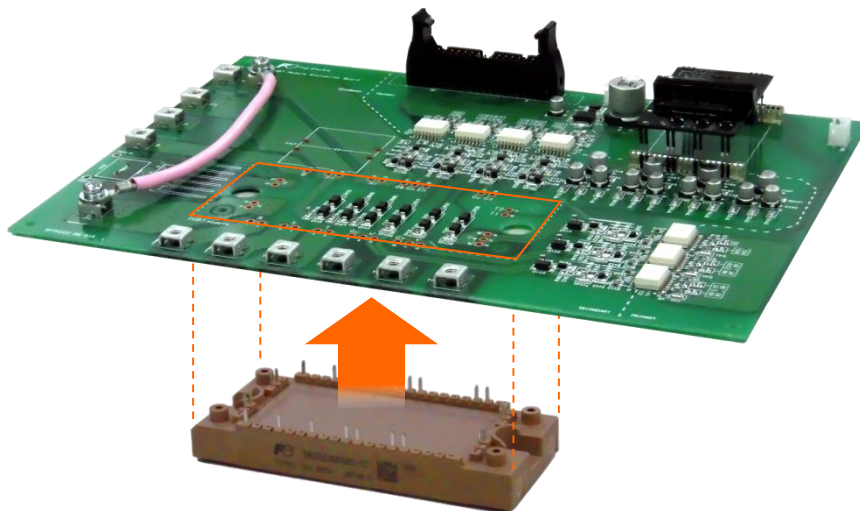
## (1) Attach IC1 (M57140-07F)



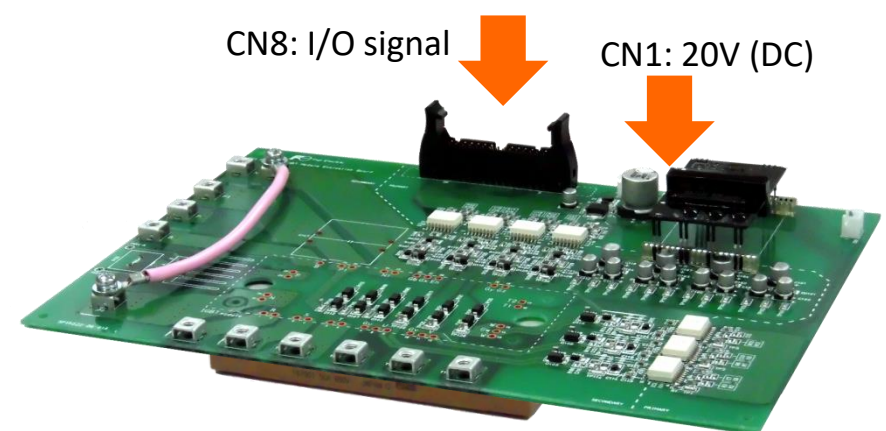
## (2) Connect JP1 and JP2



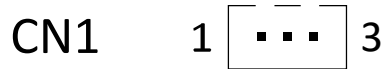
## (3) Attach and solder IGBT module to PCB



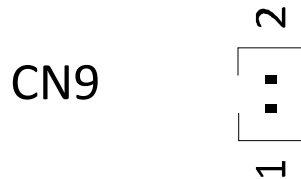
## (4) Connect I/O signal and DC power supply



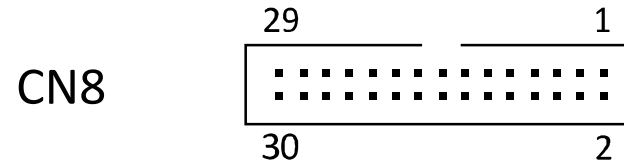
# I/O Pin Assignments



PIN No.	Pin name	Function
1	VDC_IN	+20V
2	NC	NC
3	GND	GND



PIN No.	Pin name	Function
1	T1	T1
2	T2	T2



PIN No.	Pin name	Function
1	IN-DB	PWM signal for B phase
2	NC	
3	IN-X	PWM signal for X phase
4	IN-U	PWM signal for U phase
5	IN-Y	PWM signal for Y phase
6	IN-V	PWM signal for V phase
7	IN-Z	PWM signal for Z phase
8	IN-W	PWM signal for W phase
9 - 12	GND	
13	FAULT-DB	DESAT fault output for B phase
14	UVLO-DB	Undervoltage lockout output for B phase
15	FAULT-U	DESAT fault output for U phase
16	UVLO-U	Undervoltage lockout output for U phase
17	FAULT-V	DESAT fault output for V phase
18	UVLO-V	Undervoltage lockout output for V phase
19	FAULT-W	DESAT fault output for W phase
20	UVLO-W	Undervoltage lockout output for W phase
21	FAULT-X	DESAT fault output for X phase
22	UVLO-X	Undervoltage lockout output for X phase
23	FAULT-Y	DESAT fault output for X phase
24	UVLO-Y	Undervoltage lockout output for Y phase
25	FAULT-Z	DESAT fault output for X phase
26	UVLO-Z	Undervoltage lockout output for Z phase
27 - 30	GND	

Description	Parameter	Value	Unit	Remarks
DC input voltage for DC/DC converter	$V_{DC(in)}$	18 ~ 22	V	Recommended value: 20V
DC output voltage of DC/DC converter	$V_{out1}$	+15/-6	V	Gate-Emitter voltage
Primary side control voltage	$V_{out2}$	5	V	Non-isolation
PWM signal input voltage	$V_{IN}$	0 / +5	V	
Peak output current	$I_{O(peak)}$	4	A	Follow the specification of ACPL-337J
Peak output current for gate drive per IGBT	$I_{O(peak)}$	4	A	Follow the specification of ACPL-337J
Operating temperature	$T_{opr}$	-10... +75	°C	
Storage temperature	$T_{stg}$	-20... +85	°C	
FAULT output current	$I_{FAULT}$	10	mA	Follow the specification of ACPL-337J
FAULT pin voltage	$V_{FAULT}$	5	V	Follow the specification of ACPL-337J
FAULT logic low output current	$I_{FAULT\_L}$	9.0	mA	Follow the specification of ACPL-337J
UVLO output current	$I_{UVLO}$	10	mA	Follow the specification of ACPL-337J
UVLO pin voltage	$V_{UVLO}$	5	V	Follow the specification of ACPL-337J
UVLO threshold low to high	$V_{UVLO+}$	12.5	V	Follow the specification of ACPL-337J
UVLO threshold high to low	$V_{UVLO-}$	11.3	V	Follow the specification of ACPL-337J
DESAT detection threshold	$V_{DESAT}$	7	V	Follow the specification of ACPL-337J
Output Mute Time due to DESAT	$t_{DESAT(MUTE)}$	3.0	ms	Follow the specification of ACPL-337J
Time Input Kept Low Before Fault Reset to High	$t_{DESAT(RESET)}$	3.0	ms	Follow the specification of ACPL-337J

Please refer to datasheet of ACPL-337J and M57140-07F for other characteristics.

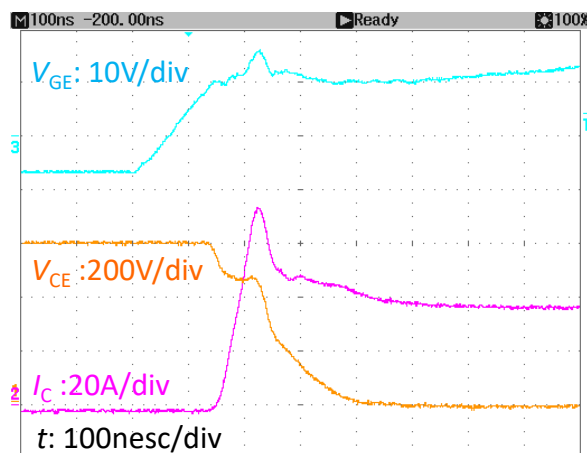
# Example of Switching Waveform

## Test condition:

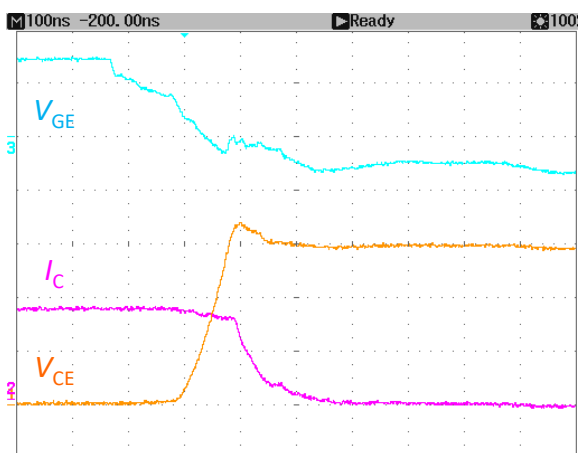
Module: 7MBR35XMA120-50

$V_{CC}=600V$ ,  $I_C=35A$ ,  $C_{snubber}=0.22\mu F$ ,  $R_G=15\Omega$ ,  $V_{GE}=+15V/-6V$ ,  $T_{vj}=R.T.$

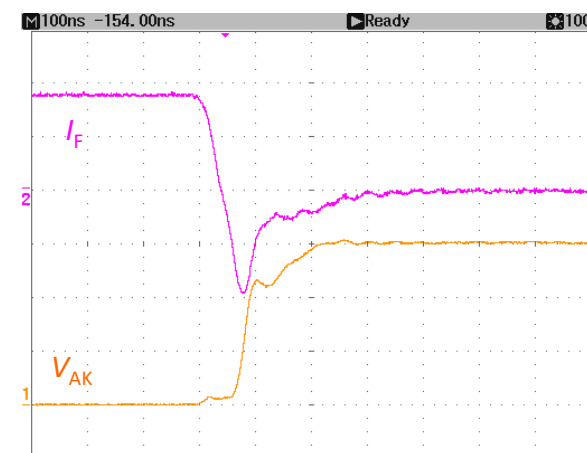
### Turn on



### Turn off



### Reverse Recovery



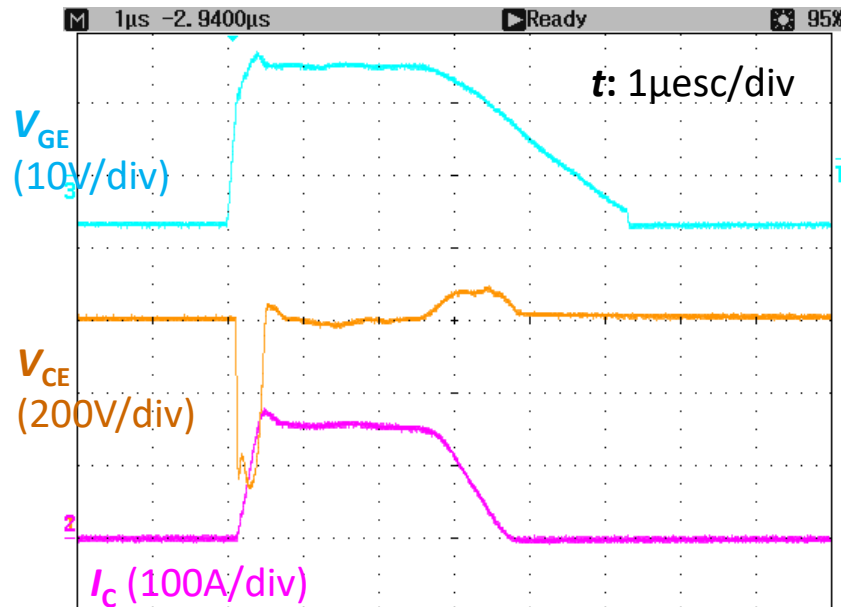
# Short Circuit Protection (DESAT)

## Test condition:

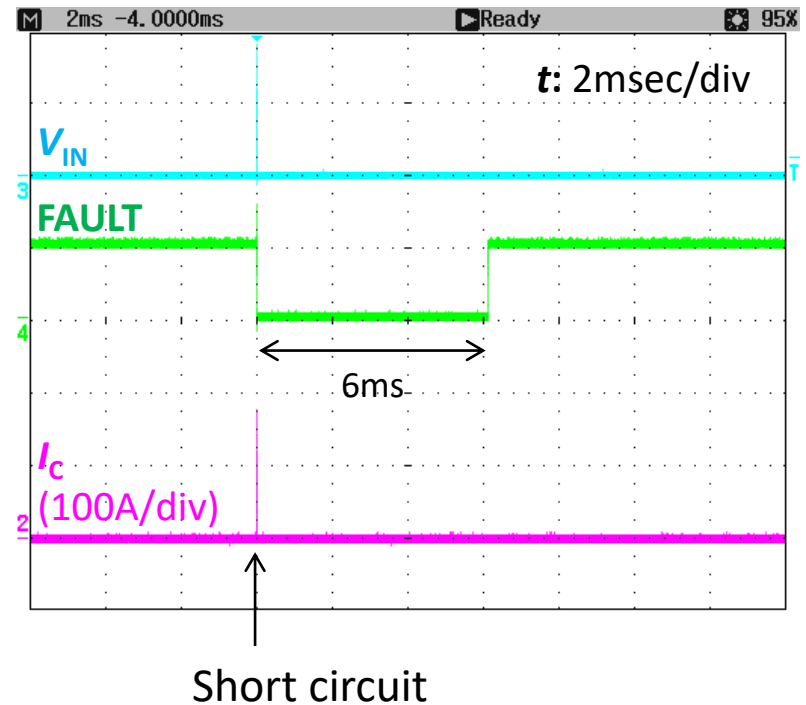
Module: 7MBR35XMA120-50

$V_{CC}=600V$ ,  $R_G=15\Omega$ ,  $V_{GE}=+15V/-6V$ ,  $T_{vj}=R.T.$

## Short circuit waveforms

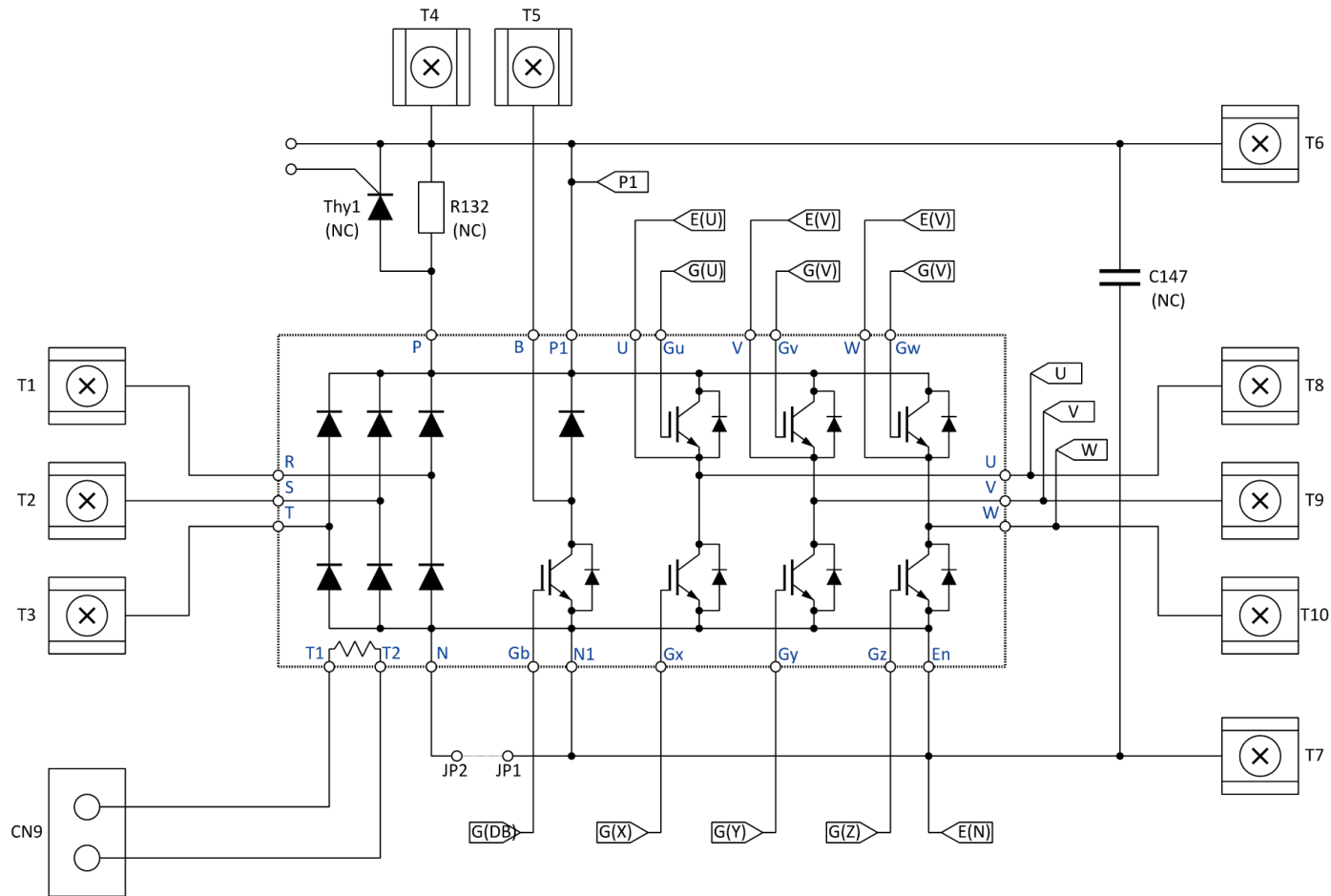


## FAULT signal output

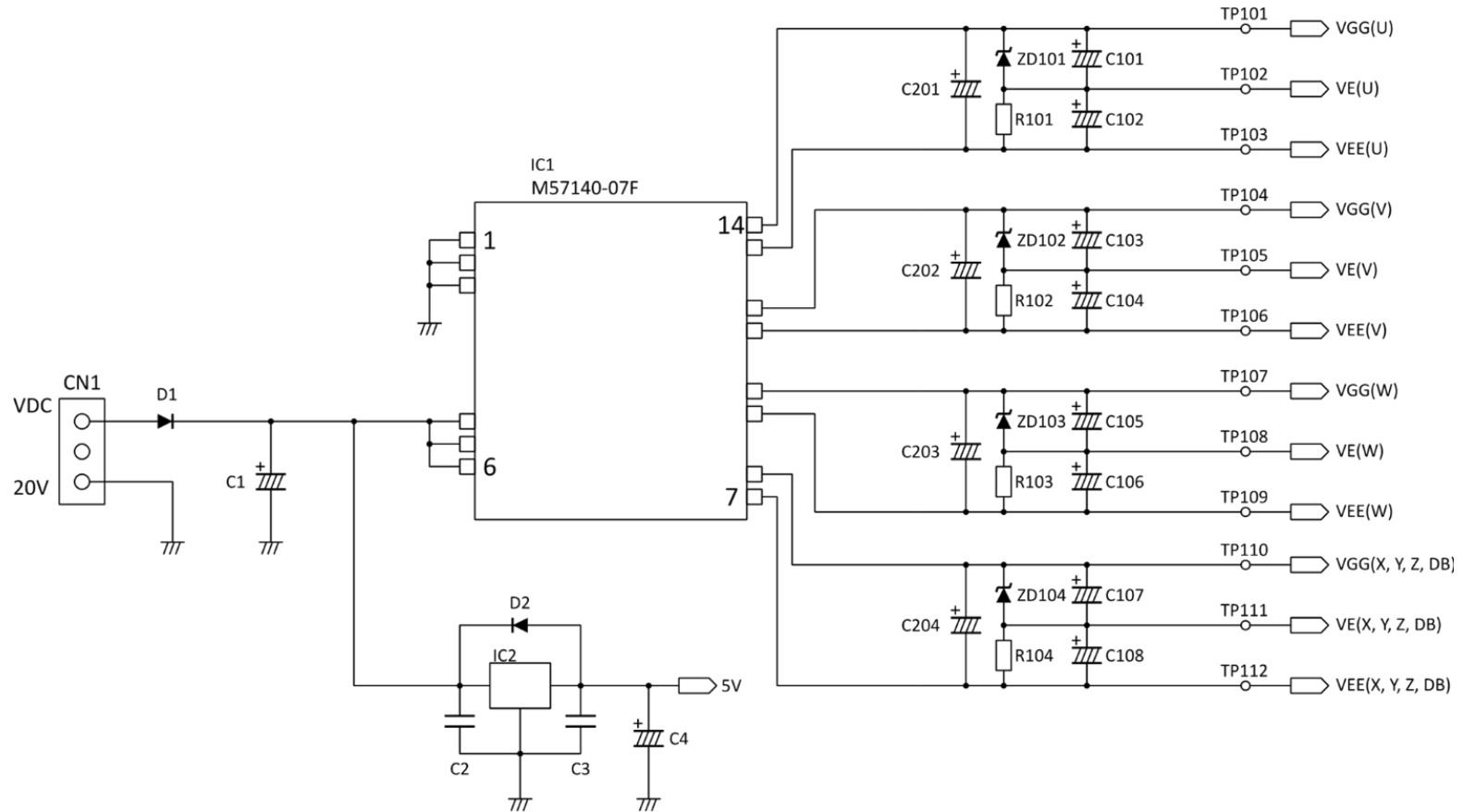




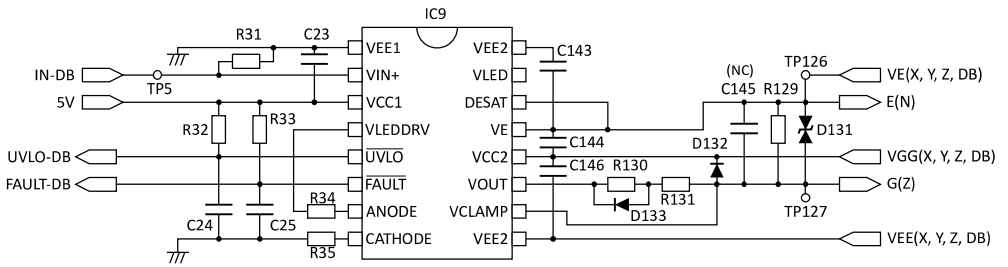
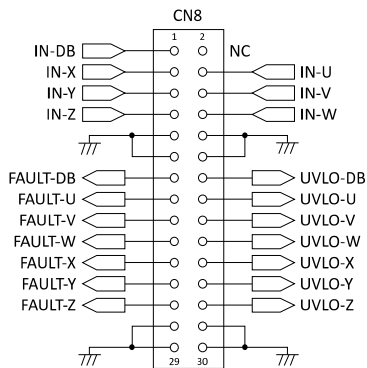
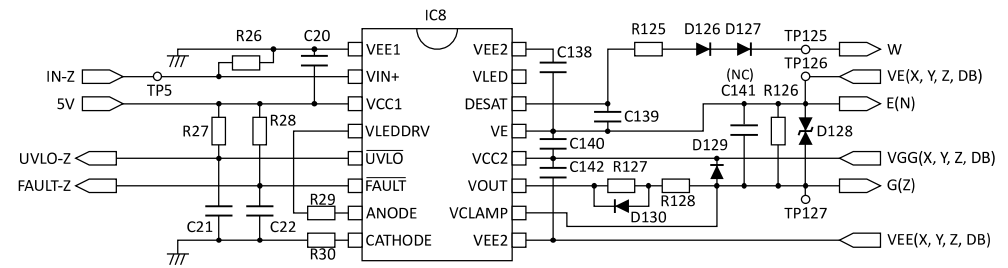
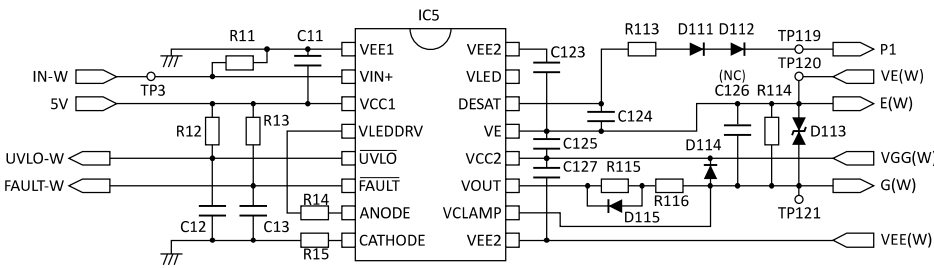
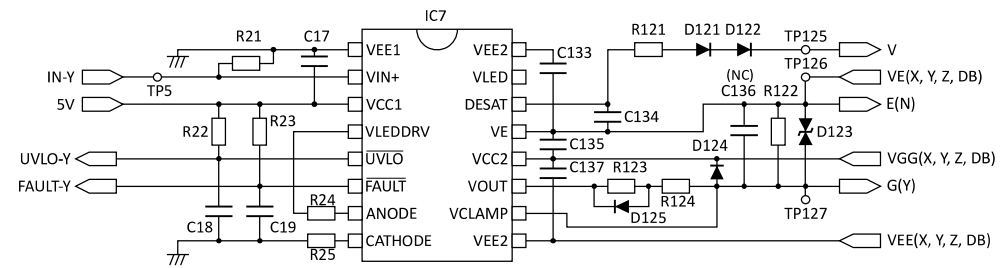
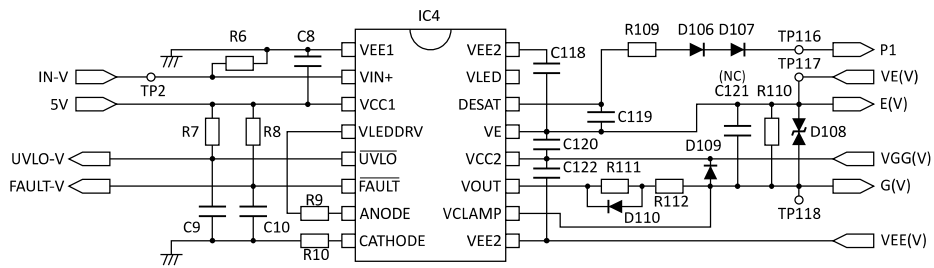
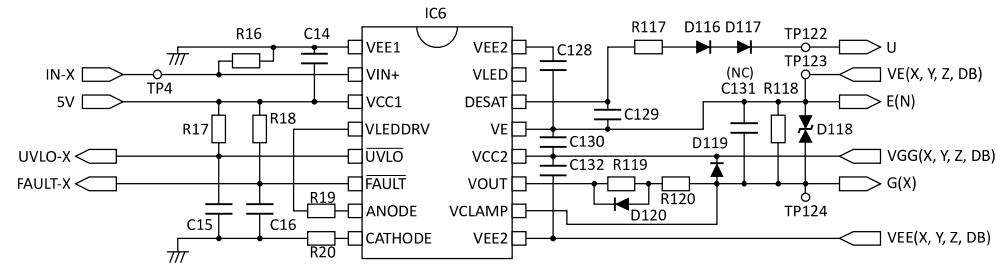
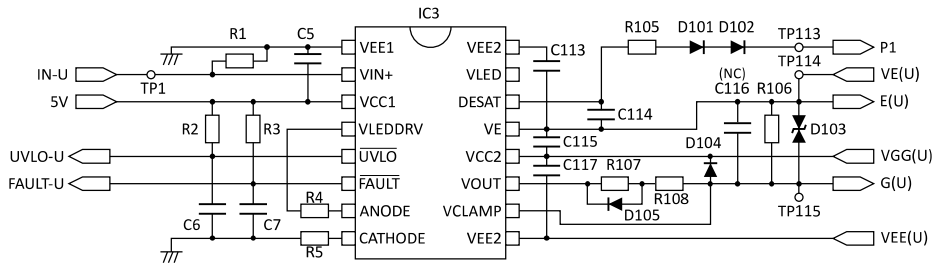
# Circuit Diagram (Main Circuit)



# Circuit Diagram (DC/DC Power Supply)



# Circuit Diagram (Gate Drive)

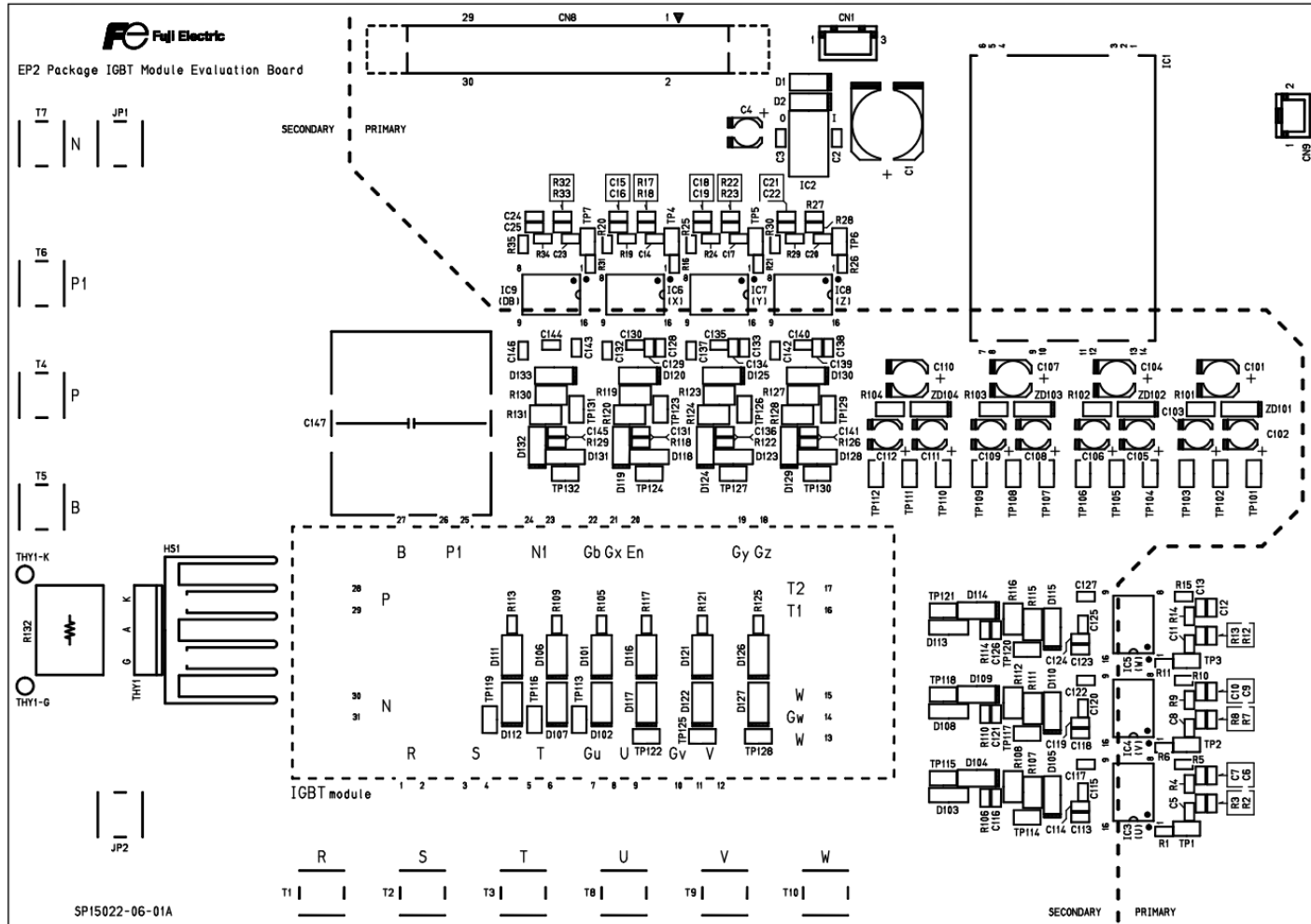


# Bill of Material

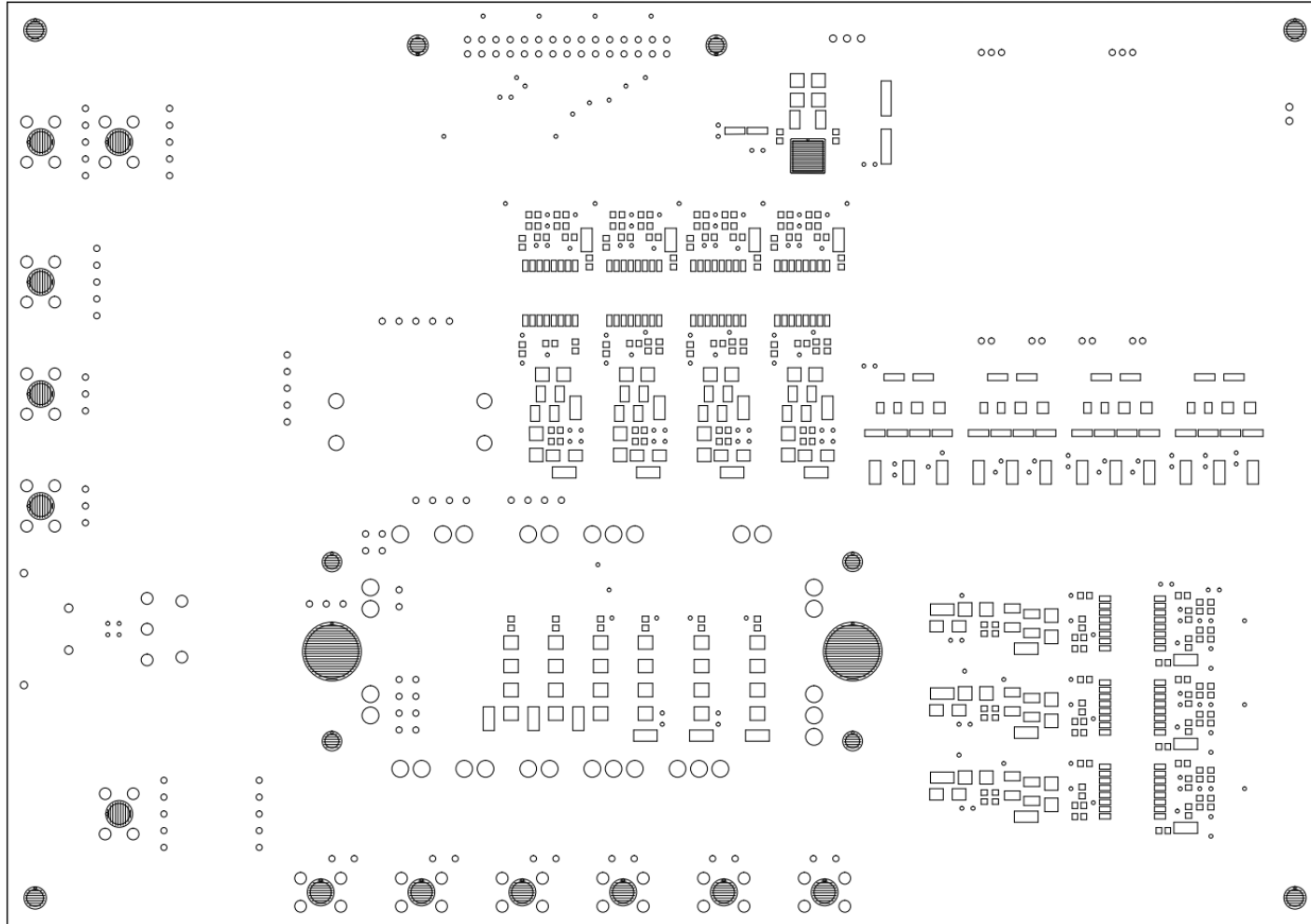
Component		Qty.	Value	Package	Manufacturer	Note
Resistor	R1, R2, R3, R6, R7, R8, R11, R12, R13, R16, R17, R18, R21, R22, R23, R26, R27, R28, R31, R32, R33, R106, R110, R114, R118, R122, R126	27	10k $\Omega$ , 1/10W	1608		
	R4, R5, R9, R10, R14, R15, R19, R20, R24, R25, R29, R30, R34, R35	14	150 $\Omega$ , 1/10W	1608		
	R101, R102, R103, R104	4	4.7k $\Omega$ , 1/4W	3216		
	R105, R109, R113, R117, R121, R125, R129	7	1k $\Omega$ , 1/10W	1608		
	R107, R111, R115, R119, R123, R127, R130	7	0k $\Omega$ , 1/2W	3225		Gate resistance: $R_G$
	R108, R112, R116, R120, R124, R128	6	15 $\Omega$ , 1/2W	3225		Gate resistance: $R_G$
	R131	1	27 $\Omega$ , 1/2W	3225		
	R132	0	3 $\Omega$ , 10W			NC
Capacitor	C1	1	330 $\mu$ F, 50V	$\phi$ 12.5 x 14.5		
	C4, C102, C103, C105, C106, C108, C109, C111, C112	9	22 $\mu$ F, 25V	$\phi$ 5 x 6		
	C101, C104, C107, C110	4	47 $\mu$ F, 25V	$\phi$ 6.3 x 6		
	C114, C119, C124, C129, C134, C139	6	220pF, 50V			
	C6, C7, C9, C10, C12, C13, C15, C16, C18, C19, C21, C22, C24, C25	14	330pF, 50V			
	C2, C3	2	0.1 $\mu$ F, 50V			
	C116, C121, C126, C131, C136, C141 C145	0		1608		NC
	C147	0				NC

# Bill of Material (Cont'd)

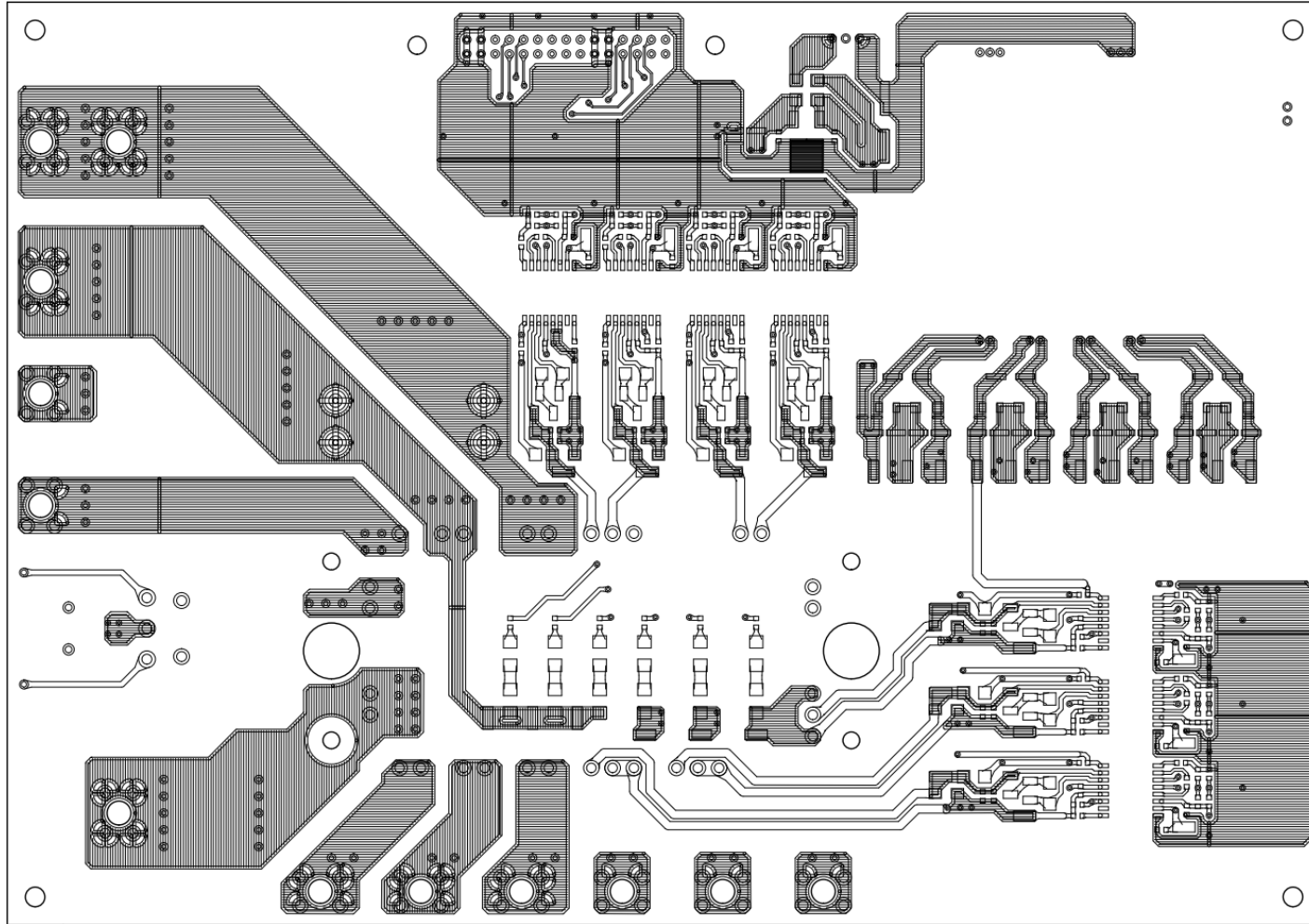
Component		Qty.	Value	Package	Manufacturer	Note
Diode	D2, D104, D105, D109, D110, D114, D115, D119, D120, D124, D125, D129, D130, D132, D133	15	40V, 1A			
	D101, D102, D106, D107, D111, D112, D116, D117, D121, D122, D126, D127	12	600V, 1A			
Zenner Diode	D101, D102, D103, D104	4	15V, 1W			
Thyristor	Thy1	0				NC
IC	IC1	1	M57140-07F		Isahaya Electronics	
	IC2	1	TA7805F			
	IC3, IC4, IC5, IC6, IC7, IC8, IC9	7	ACPL-337J		Broadcom (AVAGO Technologies)	
Connector	CN1	1	B2B-XH-A(LF)(SN)	3p		
	CN8	1	XG4A-3031	30p		
	CN9	1	B2B-XH-A(LF)(SN)	2p		
Terminal	T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12	12	PCB-9 M4			
Test Pin	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP101, TP102, TP103, TP104, TP105, TP106, TP107, TP108, TP109, TP110, TP111, TP112, TP113, TP114, TP115, TP116, TP117, TP118, TP119, TP120, TP121, TP122, TP123, TP124, TP125, TP126, TP127, TP128, TP129, TP130, TP131, TP132, TP133	40	HK-2-S			
PCB	SP15022-06-01A	1				



(Top Silkscreen Layer)

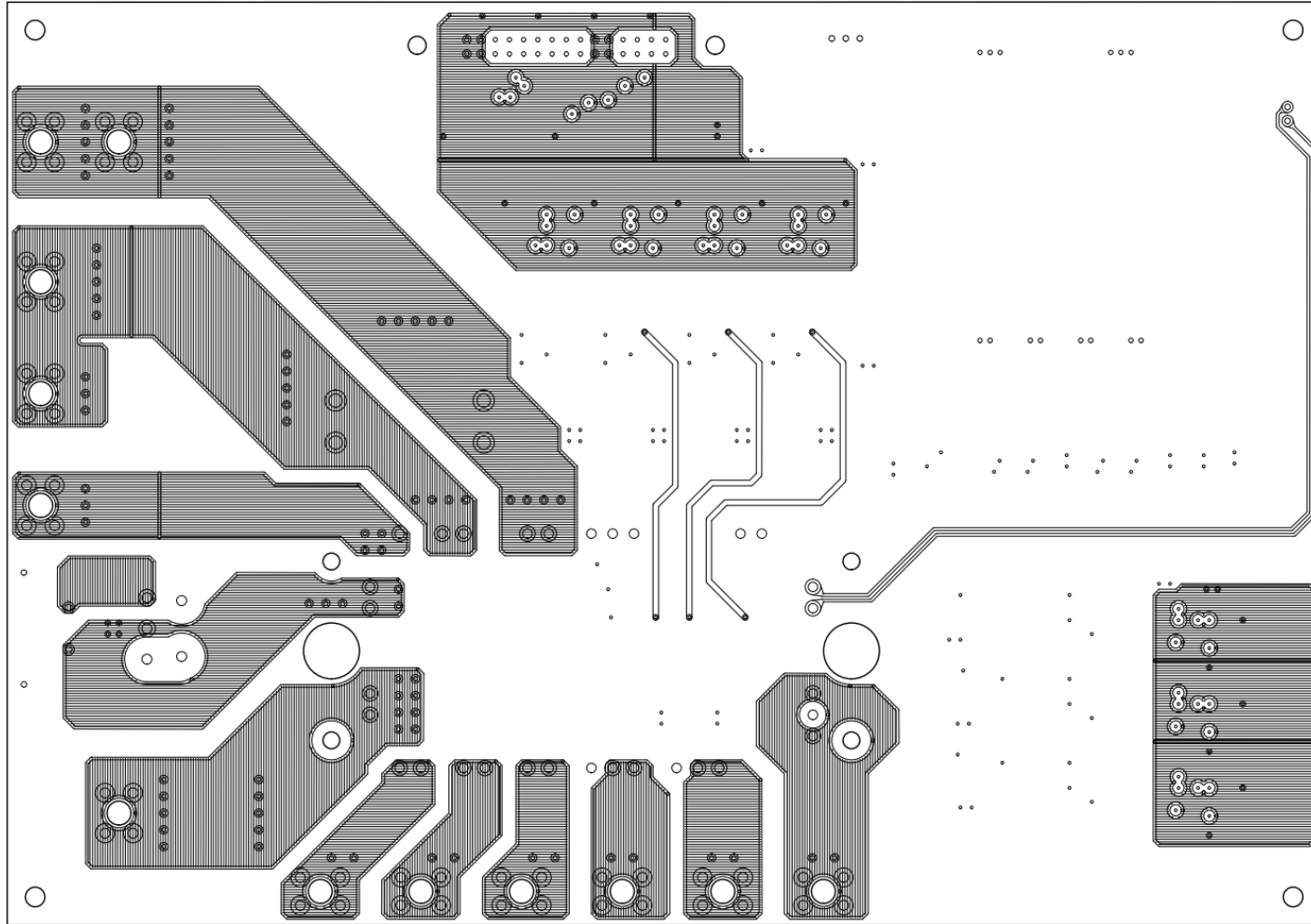


**(Top Solder Resist Layer)**

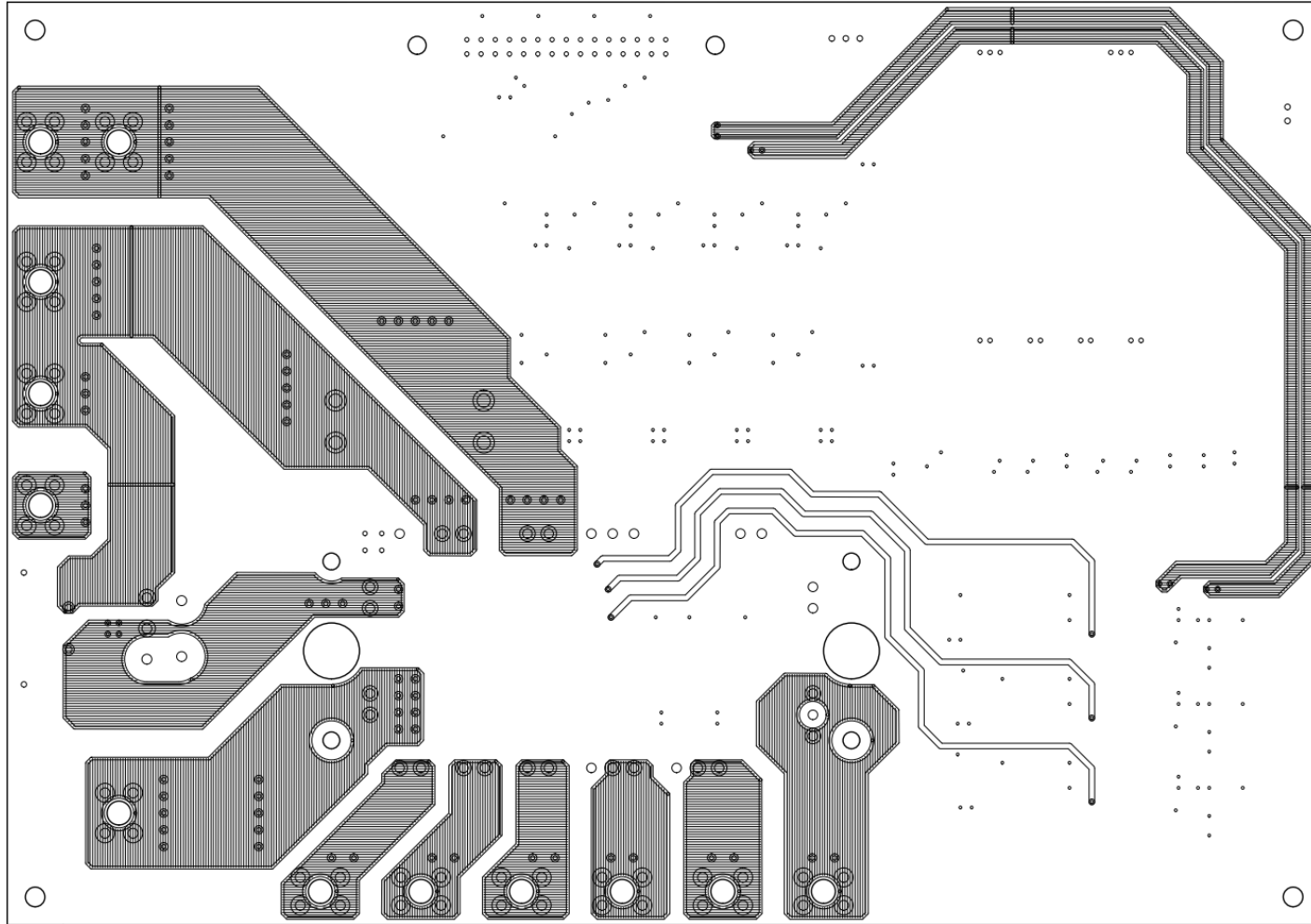


**(Top Layer)**

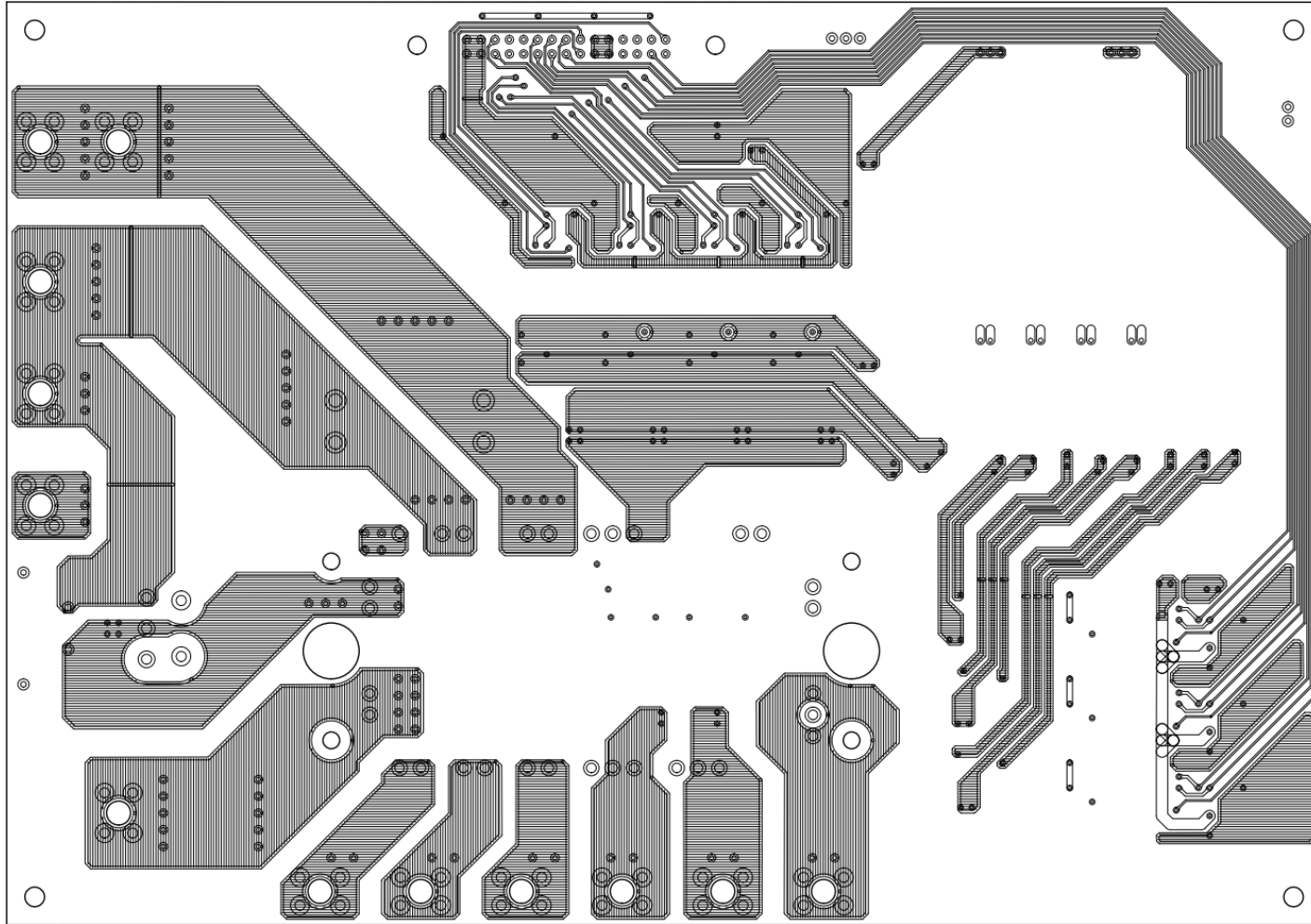




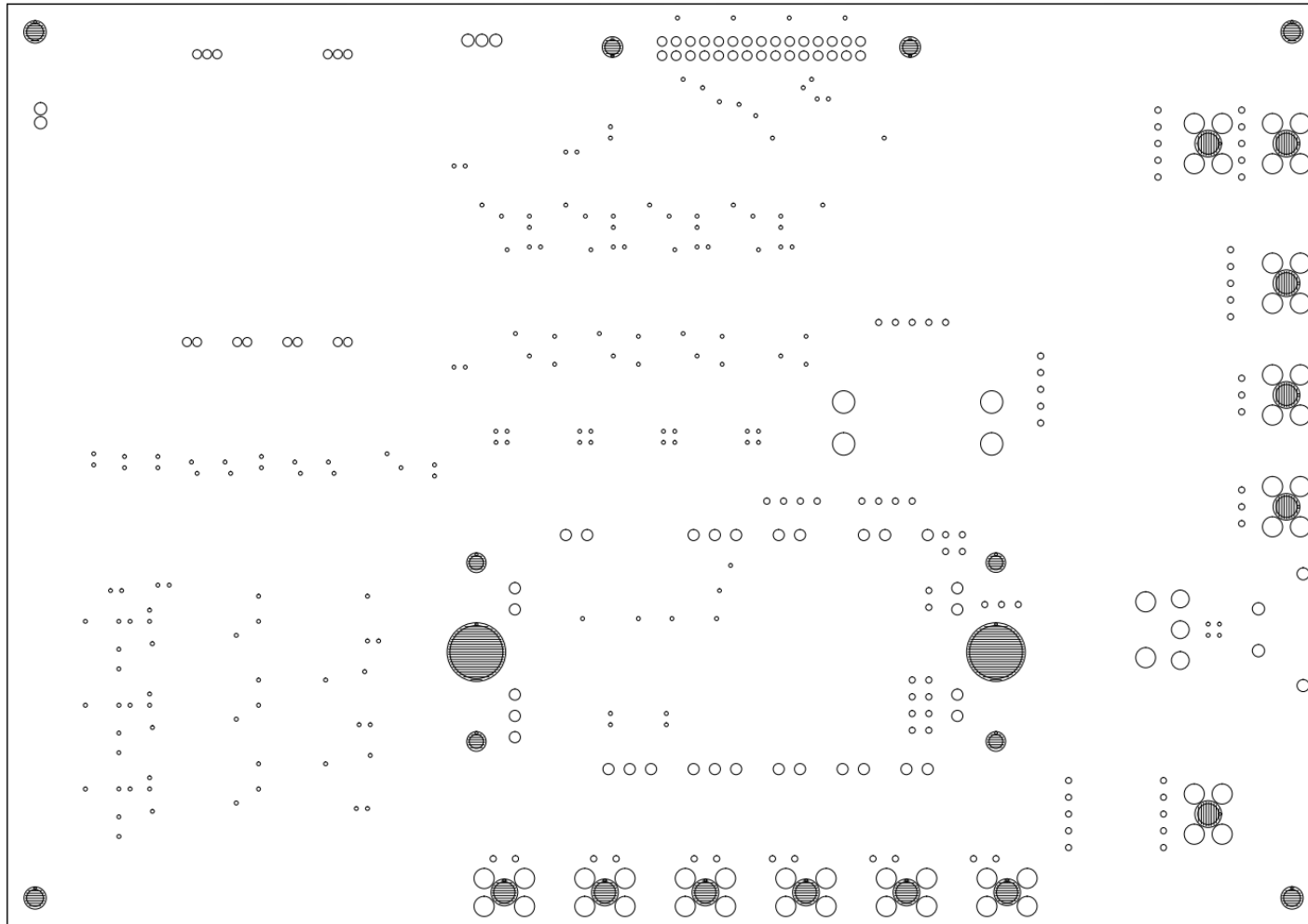
**(Layer 2)**



**(Layer 3)**



**(Bottom Layer)**



**(Bottom Solder Resist Layer)**

This evaluation board can be ordered via a representative at our company or one of our dealers.  
CAD-data and gerber-data for this evaluation board are also available on request.

If you don't know the contact address, please request through our website:  
[www.fujielectric.com/products/semiconductor/contact/](http://www.fujielectric.com/products/semiconductor/contact/)

For more information, please visit our website: [www.fujielectric.com/products/semiconductor/](http://www.fujielectric.com/products/semiconductor/)

1. This Catalog contains the product specifications, characteristics, data, materials, and structures as of September 2022. The contents are subject to change without notice for specification changes or other reason. When using a product listed in this Catalog, be sure to obtain the latest specifications.
2. All applications described in this Catalog exemplify the use of Fuji's products for your reference only. No right or license, either express or implied, under any patent, copyright, trade secret or other intellectual property right owned by Fuji Electric Co., Ltd. is (or shall be deemed) granted. Fuji Electric Co., Ltd. makes no representation or warranty, whether express or implied, relating to the infringement or alleged infringement of other's intellectual property rights which may arise from the use of the applications described herein.
3. Although Fuji Electric Co., Ltd. is enhancing product quality and reliability, a small percentage of semiconductor products may become faulty. When using Fuji Electric semiconductor products in your equipment, you are requested to take adequate safety to prevent the equipment from causing a physical injury, fire, or other problem if any of the products become faulty. It is recommended to make your design failsafe, flame retardant, and free of malfunction.
4. The products introduced in this Catalog are intended for use in the following electronic and electrical equipment which has normal reliability requirements.
  - Computers                      - OA equipment                      - Communications equipment (terminal devices)                      - Measurement equipment
  - Machine tools - Audiovisual equipment                      - Electrical home appliances - Personal equipment                      - Industrial robots etc.
5. If you need to use a product in this Catalog for equipment requiring higher reliability than normal, such as for the equipment listed below, it is imperative to contact Fuji Electric Co., Ltd. to obtain prior approval. When using these products for such equipment, take adequate measures such as a backup system to prevent the equipment from malfunctioning even if a Fuji's product incorporated in the equipment becomes faulty.
  - Transportation equipment (mounted on cars and ships)                      - Trunk communications equipment                      -Traffic-signal control equipment
  - Gas leakage detectors with an auto-shut-off feature                      - Emergency equipment for responding to disasters and anti-burglary devices
  - Safety devices                      - Medical equipment.
6. Do not use products in this Catalog for the equipment requiring strict reliability such as the following and equivalents to strategic equipment (without limitation).
  - Space equipment                      - Aeronautic equipment                      - Nuclear control equipment                      - Submarine repeater equipment
7. All rights reserved. No part of this Catalog may be reproduced without permission in writing from Fuji Electric Co., Ltd.
8. If you have any question about any portion in this Catalog, ask Fuji Electric Co., Ltd. or its sales agents before using the product. Neither Fuji Electric Co., Ltd. nor its agents shall be liable for any injury caused by any use of the products not in accordance with instructions set forth herein.