सत्यमेव जयते
भारत सरकार
GOVERNMENT OF INDIA
भाभा परमाणु अनुसन्धान केन्द्र
BHABHA ATOMIC RESEARCH CENTRE
ELECTRONICS AND INSTRUMENTATION GROUP
CONTROL INSTRUMENTATION DIVISION

भाभा परमाणु अनुसंधान केंद्र
BHABHA ATOMIC RESEARCH CENTRE

TELEPHONE:
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ट्रॉम्बे **TROMBAY**
मुम्बई **MUMBAI - 400 085**

Ref: CnID/SES/YRS/2021/MF/INQ/P20272 Date: 20/12/2021

Minor Fabrication (MF)- Invitation of quotations

Sub: Fabrication, testing and supply of current fed 4-phase switched reluctance motor control system along with spare components as per Annexure-I.

Dear Sir/Madam,

1. Quotations are invited for the minor fabrication job as per enclosed Annexure-I.
2. No insurance policy is required as no free issue material (FIM) is issued to supplier.
3. Taxes shall be quoted separately. The above work is required for R & D works.
4. PAN and GST nos. of suppliers are mandatory along with offer.
5. The quotations must reach Head, Control Instrumentation Division by **07/01/2022, 18:00 Hrs** and must be sent in a sealed envelope super-scribed with the above reference number by speed post and due date given above.
6. The address on the envelope should read:

   The Head,
   Control Instrumentation Division, RCnD Bulding,
   Bhabha Atomic Research Centre,
   North Site, Trombay, Mumbai-400 085.

7. The fabrication work shall be subject to inspection by our engineer. The finished component shall not be dispatched prior to approval by our engineer at supplier's premises. Necessary inspection facilities should be provided to our engineers during fabrication at supplier's premises.
8. The supplier shall deliver the finished components after approval by our engineer, within 6 months from the date the firm work order issued to the supplier.
9. Head, Control Instrumentation Division, BARC, reserve the right to accept/reject any or all quotations without assigning any reason.
10. Supplier should clearly indicate the delivery period.
11. Supplier shall quote for all items given in minor fabrication. Incomplete offer/Part offer/offer received after due date will not considered.
12. Quotations should be preferably neatly typed and corrections are not acceptable.
13. For detailed study, Annexure-I and Annexure-II may please be downloaded from the BARC site http://www.barc.gov.in.

Encl.: as above

श्रीमती अनुराधा मैय्या / Smt. Anuradha Mayya
अध्यक्ष, नियंत्रण यंत्रीकरण प्रभाग
Head Control Instrumentation Division
भाभा परमाणु अनुसंधान केंद्र
Bhabha Atomic Research Centre
भारत सरकार/Government of India
ट्रॉम्बे, मुंबई-४०००८५/ Trombay, Mumbai-400085.

20/12/21
Head, CnID

Annexure I

1. Scope:

This Minor Fabrication covers manufacturing, testing and supply of current fed 4-phase switched reluctance motor control system. Specifications, drawings, circuit design, Bill of Material (BoM), testing requirements etc. of this control system are given in following sub-sections of this annexure.

1.1. Scope of supply:

The supplier shall manufacture, test and supply the motor control system as per design files/drawings - electrical circuit diagrams, PCB artwork Gerber data, mechanical drawings, bill of material with their detailed specification, test procedure etc. - given by purchaser. The supplier shall supply the following items in quantities as indicated in Table 1.

Table 1: List of items

Sr. No.	Items	Quantity
1	**Current fed 4-phase switched reluctance motor control system consisting of 1 No. wired and tested standard 19" EURO bin with all internal modules and fittings**	1 Set
2	**Spare components**	
	Resistors: SMD, 1206 package, 0.25W 100E, 330E,1K, 2K, 3K, 3K9, 4K7, 10K, 12K,15K, 20K, 33K,47K, 68K, 430K, 1M and 100K	100 Nos. Each
	Resistors: 47E, 2%, 3W, Through hole, Part No. CPF347R000GKB14	10 Nos. Each
	Resistors: 10K, 1%, 3W, Through hole, Part No. CPF310K000FKE14	10 Nos.
	Capacitors: SMD, 1206 package 0.1uF/200V, 0.1uF/50V, 1uF/25V, 2.2uF/25V, 4.7uF/50V, 10uF/25V, 22pF/50V, 100pF/50V, 1nF/50V, 0.47uF/50V, 33pF/50V	100 Nos. Each
	Capacitors: SMD, 2220 package 22uF/25V	20 Nos.
	Diodes: SMD package MRA4007, 1N4148, PMLL4448	20 Nos. Each
	Capacitor: 47nF/400V, Axial Type , Part No: MKP1839347404	20 Nos.
	X-Capacitor: 0.47 uf / 250 VAC, Part No: F17724472030	10 Nos.
	Y- Capacitor: 4700pf /250 VAC, Part No: P271HL472M250CR06	10 Nos.
	Y- Capacitor: 0.01uf /250 VAC, Part No: F1710-310-1000	20 Nos.
	Reference Diode: SMD package Part No: LM236D-2.5V, SOIC 6 Pin, SMD	06 Nos.
	Diode: Through hole package Part No. SF20L60U	10 Nos.
	Diode: Through hole package Part No. STTH1R06	10 Nos.

	Common Cathode Diodes: Through hole package Part No. SBR30300CTFP		04 Nos.
	Differential Mode Choke: 22uH, 5Amp, Part No: IHLP4040DZER220M11 20uH/10A, Part No: 31742, Vicor make 200 nH /40A, Part No: 30268, Vicor make		03 Nos. Each
	DC-DC Converter: Input 300 VDC, O/p 95 VDC, 200W, Part No. VI-26B-CU, Vicor make		01 No.
	DC-DC Converter: Input 36-140V, O/p 12V, 10W, Part No. MGDSK10QE, Make GAIA		01 No.
	DC-DC Converter: Input 9-36V, O/p 5V, 4W, Part No. MGDSK04HC, Make GAIA		01 No.
	DC-DC Converter: Input 18V, O/p 15V, 1.5W, Part No. MGS1R51215, Make Cosel		03 Nos.
	ICs:		
	Description	**Part No., Make and Type**	
	Quad 2-Input NAND Gate	CD4011BM, SOIC 14 pin	20 Nos.
	Quad Exclusive-OR Gate	CD4030BM, SOIC 14 pin	20 Nos.
	Quad 2-Input AND Gate	CD4081BM, SOIC 14 pin	20 Nos.
	Quad 2-Input OR Gate	CD4071BM, SOIC 14 pin	20 Nos.
	Divide by N Counter	CD4059A, 24 PIN IC	05 Nos.
	Binary Counter/Divider	CD4060B, 16 PIN IC	20 Nos.
	Dual D flip Flop	CD4013BM, SOIC 14	15 Nos.
	Hex Schmitt Triggers	CD40106B, 14 pin IC	20 Nos.
	Digital to Analog Converters	LTC7541A, 18 PIN IC	05 Nos.
	Operational amplifier	CA3140AMZ, 8 Pin IC	05 Nos.
	Up/Down Counter	CD40193, 16 pin IC	20 Nos.
	Quad AND/OR Select Gate	CD4019b, 16 pin IC	20 Nos.
	Dual Operational Amplifier	LM258, 8 PIN IC	20 Nos.
	CMOS Bilateral Switch	CD4066b, 16 PIN IC	20 Nos.
	Differential comparator	LM239, 14 PIN IC	20 Nos.
	Monostable Multi-vibrator	CD4047b, 14 pin IC	05 Nos.
	Opt coupler	ILD213T, 8 pin IC	20 Nos.
	Opt coupler	H11L1, 6 PIN IC	15 Nos.
	Solid state relay	LBB127S, 8 pin IC	04 Nos.
	Hex Inverting Buffer/Converter	CD4049UB, 16 PIN IC	20 Nos.
	NPN Transistor	BC817-25,SOT23 package	10 Nos.
	MOSFET/IGBT Driver	IR2113, 16 PIN IC	08 Nos.
	3.3V Regulator	MIC5209-3.3YS-TR, SOT-223-3	03 Nos.
	16-bit Digital Signal Controllers	dsPIC33FJ256GP710A, 100 pin, TQFP package	02 Nos.
	Octal buffer/line driver; 3-state	74HCT541D, SOIC 20	05 Nos.
	Dual Processor Supervisors With Watchdog	ADM13305-33ARZ, SOIC 8	04 Nos.
	QAUD Two input NOR gate	CD4001BM, SOIC 14	15 Nos.
	Euro Connectors: H15, Socket type, Part No: 09062152811		07 Nos.

	Euro Connectors: 48 pin, Socket type, Part No: 09062486823	05 Nos.
	Current Transducer (CT): Hall effect closed loop, Primary current (Max) 25 Amp, Part No: LAH 25-NP	04 Nos.
	MOSFET: V_{dc} = 600 V, I_d = 47 Amp , V_{gs}:±20 V, V_{gs}th = 3 V, Part No: IXKR47N60C5	12 Nos.
	IGBT: V_{ce} = 600 V, I_c = 52 Amp , V_{gs}:±20 V, Part No: IRG4PC50KDPBF	07 Nos.
	Ring Type Lug: 18-22 AWG Wire Gauge, Crimp Type termination with Insulation, Stud Size #8	100 Nos.
	Ring Type Lug: 18-22 AWG Wire Gauge, Crimp Type termination with Insulation, Stud Size #6	100 Nos.
	Ring Type Lug: 14-16 AWG Wire Gauge, Crimp Type termination with Insulation, Stud Size #8	100 Nos.
	Ring Type Lug: 22-26 AWG Wire Gauge, Crimp Type termination with Insulation, Stud Size #6	100 Nos.
	Slotted Ring Lug: 22-26 AWG Wire Gauge, Crimp Type termination with Insulation, Stud Size #6,	100 Nos.
	Slotted Ring Lug: 16-22 AWG Wire Gauge, Crimp Type termination with Insulation, Stud Size #6	100 Nos.
	Slotted Ring Lug: 16-22 AWG Wire Gauge, Crimp Type termination with Insulation, Stud Size #8	100 Nos.
	Bullet type lugs: 18-22 AWG Wire Gauge, Crimp Type termination with Insulation, Pin diameter 1.78 mm,	100 Nos.
	Bullet type lugs: 14-16 AWG Wire Gauge, Crimp Type termination with Insulation, Pin diameter 1.78 mm	100 Nos.
	Bullet type lugs: 22-26 AWG Wire Gauge, Crimp Type termination with Insulation, Pin diameter 1.14 mm	100 Nos.
	Blade type lugs: 18-22 AWG Wire Gauge, Crimp Type termination with insulation, Tab Thickness 0.79 mm, Width 2.21 mm	100 Nos.
	Blade type lugs: 14-16 AWG Wire Gauge, Crimp Type termination with insulation, Tab Thickness 0.79 mm, Width 2.21 mm	100 Nos.
	Pipe type insulated single end lug: 1 Sq. mm, 8mm Pin length	100 Nos.
	Pipe type insulated single end lug:	100 Nos.

	0.5 Sq. mm, 10 mm Pin length	
	Pipe type insulated twin end lug: 1.5 Sq. mm, 8 mm Pin Length	100
	Ratcheting Ferrule Crimper Tool: Crimping Capacity: AWG 23-10	01 No.
	Wire Crimping tool: Crimping Capacity: 0.5 to 6 mm²	2 Nos.

2. Technical Requirements of Motor Control System:

Figure 1 is block schematic of motor control system. The system receives Up command, Down command, TRIP command, Limit Switch contact, 230V, 1ϕ, 50 Hz input supply and produces required electrical output for its corresponding motor. The motor control system shall be implemented in single 19", 4U height standard EURO bin. The system shall have following modules/items.

i. Rectifier module: 1 No.
ii. 96V DC Power Supply (PS) module: 1 No.
iii. Control module: 1 No.
iv. Power module: 2 Nos.
v. Command control module: 1 No.
vi. DC link Capacitor plate: 1 No.

Figure 2 shows General Arrangement (GA) of motor control system. Brief description of each module of the system is given in the following sub-sections. Motor control system receives one Up, one Down and one TRIP command in the form of dry contacts. These commands are duplicated and resolved as per '1 out of 2' or '2 out of 2' logic. System also receives one limit switch contact.

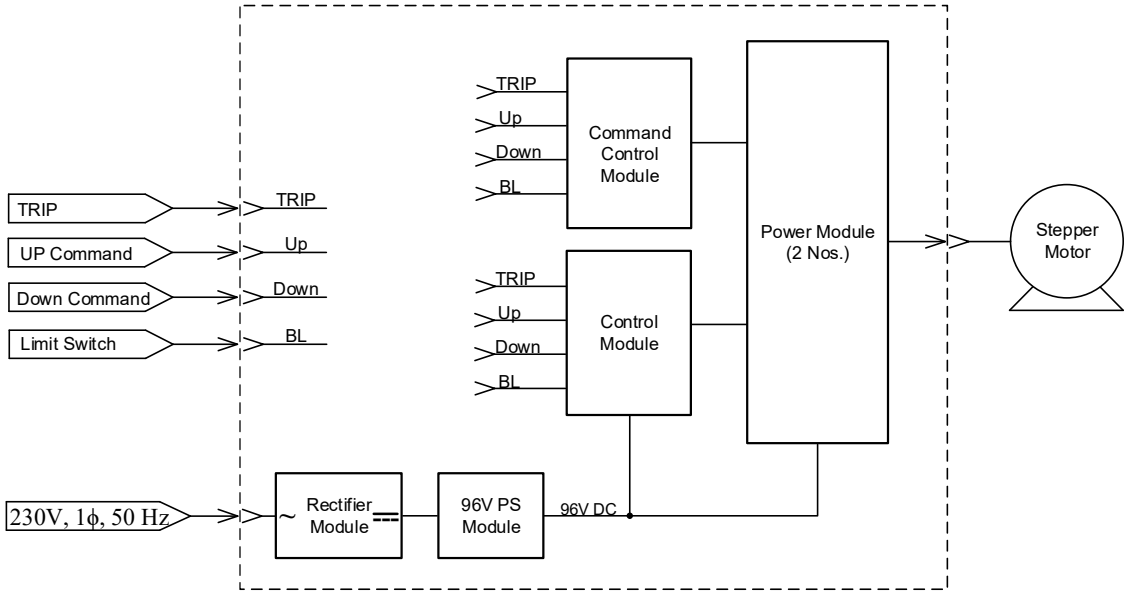


Figure 1: Block schematic of current fed 4-phase switched reluctance motor control system

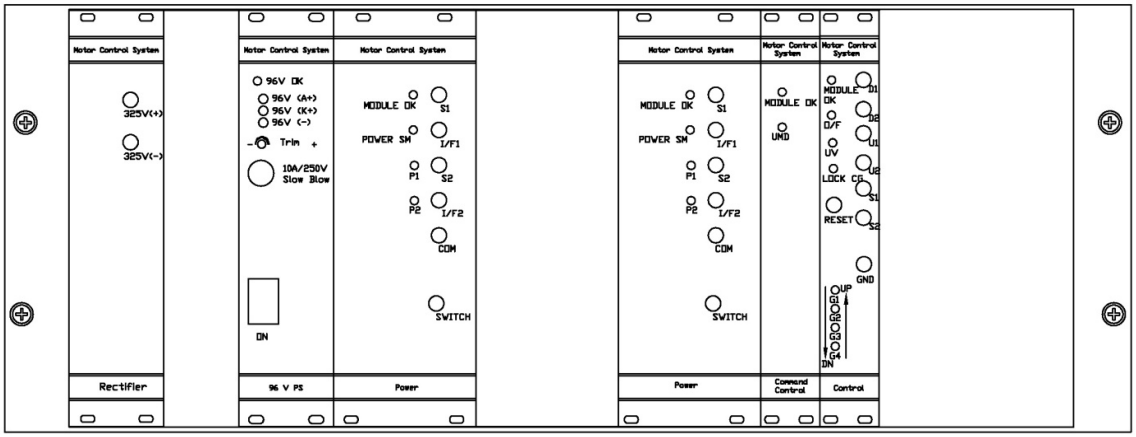


Figure 2: GA of current fed 4-phase switched reluctance motor control system

2.1.1. Control Input:

Motor control system receives one Up, one Down and one TRIP command in the form of dry contacts. These commands are duplicated and resolved as per '1 out of 2' or '2 out of 2' logic. System also receives one limit switch contact.

2.1.2. Power Input:

The motor control system receives 230V, 1ϕ, 50 Hz supply with the rating as given below:

Input voltage: 230V ±10%, 1ϕ
Input frequency: 50Hz ±5%

2.1.3. Power Output:

The motor control system shall produce following output as per input command:

Current waveform	: Refer Figure 3
Voltage/phase	: Pulse width modulated voltage
Current/phase	: 90^0 displaced, 2 ampere peak triangular wave shape current for 4 phases, or 1 amperes DC current in any two of the 4 phases of the motor.
Frequency	: Continuously settable at any value between 0.1 Hz to 15 Hz
Phase	: 4
Duty	: Continuous

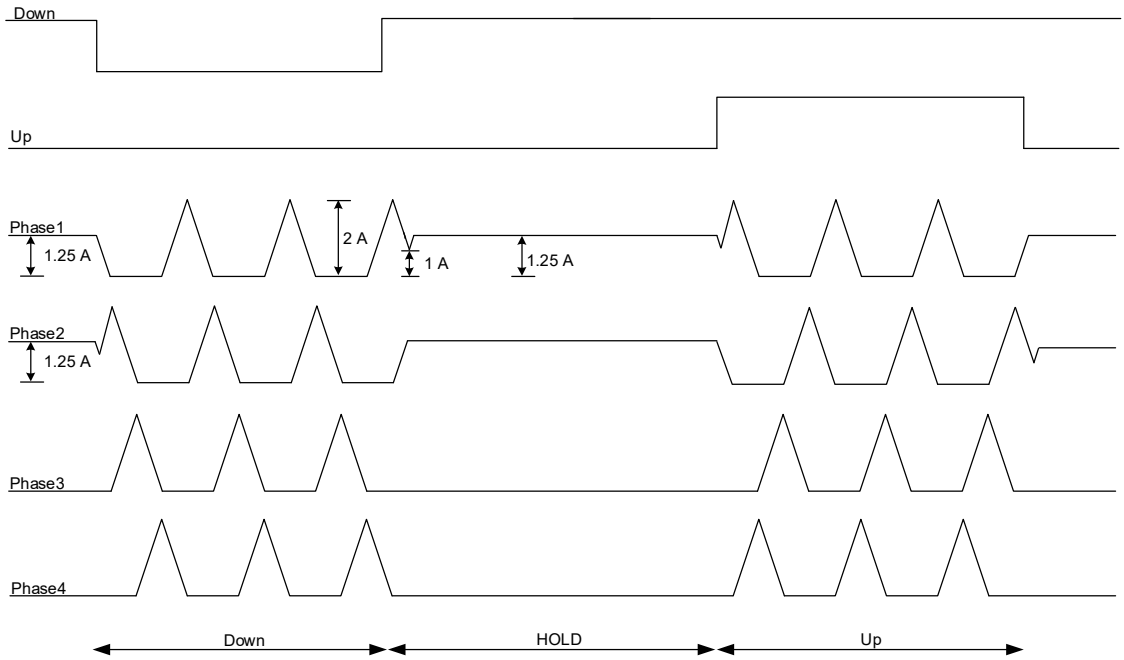


Figure 3: Motor control system output current waveform Vs command signals

2.1.4. Control Input and Power Output Logics:

Sr. No.	Control inputs to the motor control system		Power output from EDS
	Up command	Down command	
1	0	0	Down mode power at output for motor control system*
2	0	1	Hold mode power at output for motor control system*
3	1	0	Up mode power at output for motor control system*
4	1	1	CW mode power at output for motor control system*

*At the transition from "Down" mode power to "Hold" mode power, drive shall ensure that the running cycle is completed.

3. Function Description:

3.1. Rectifier Module:

Figure 4 is block schematic of rectifier module. Rectifier module is 8T module. Module receives 230 Volts, 1Φ, 50 Hz and generates 325 Volts DC bus for motor control system. Design data – electrical schematic, Bill of Material and PCB layout – of module is given in Annexure II.

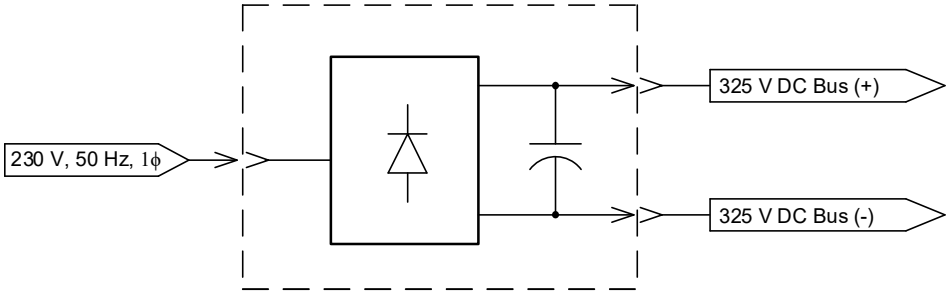


Figure 4: Block schematic of rectifier module

3.2. 96V PS Module:

Figure 5 is block schematic of 96V PS module. 96V PS module is 8T module. The module consists of one No. of 96V, 200W DC-DC converter with required components for series or parallel connection of two modules. Module shall have module diagnostic circuit. Design data – electrical schematic, Bill of Material and PCB layout – of module is given in Annexure II.

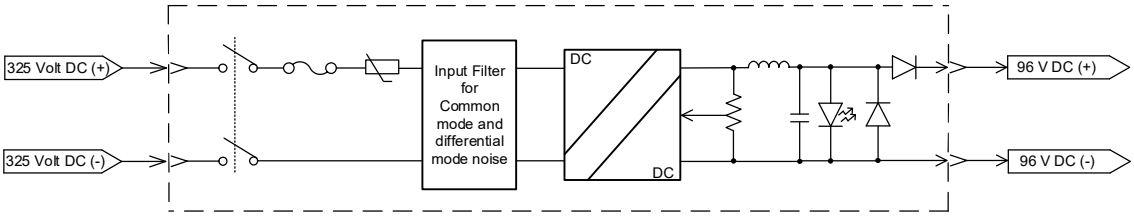


Figure 5: Block Schematic of 96V PS module

3.3. Control Module:

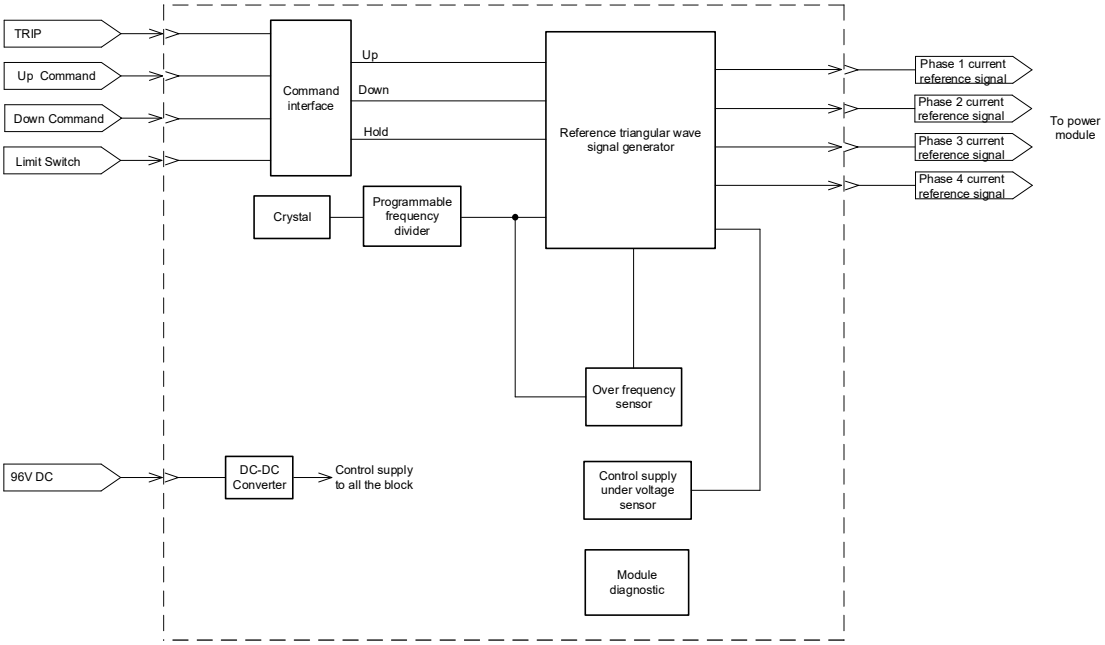


Figure 6 is block schematic of control module. Control module is 5T module. Module receives 96V DC input, Up, Down, Trip commands and limits switch contact and produces four Nos. of current reference signals for power modules. Module shall have module diagnostic circuit. Design data – electrical schematic, Bill of Material and PCB layout – of module is given in Annexure II.

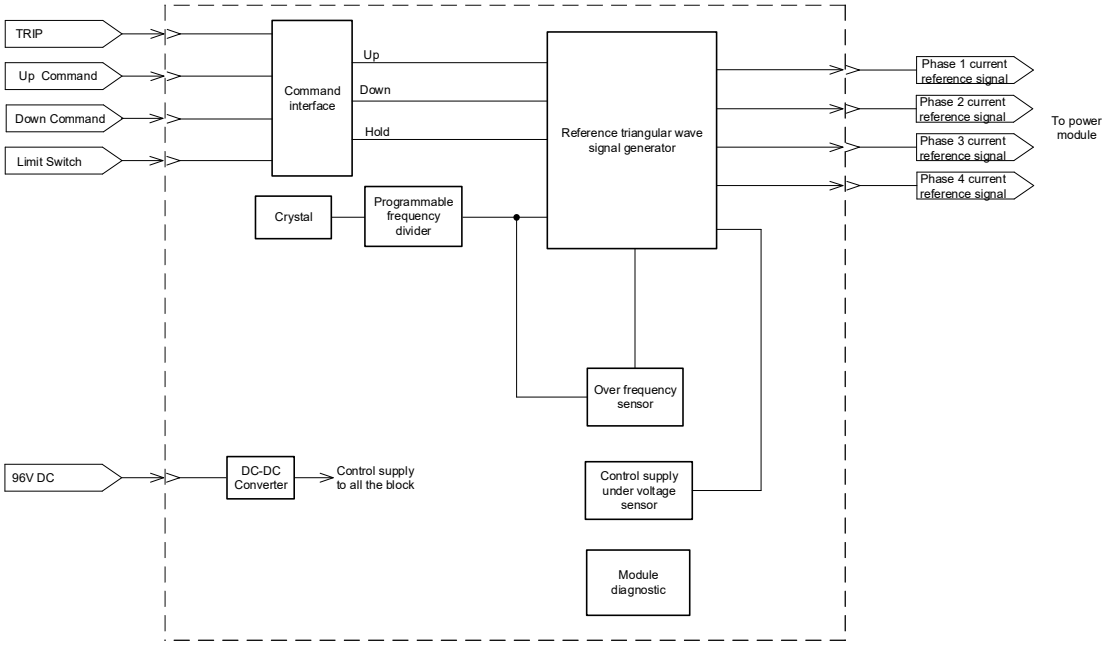


Figure 6: Block schematic of control module

3.4. Power Module:

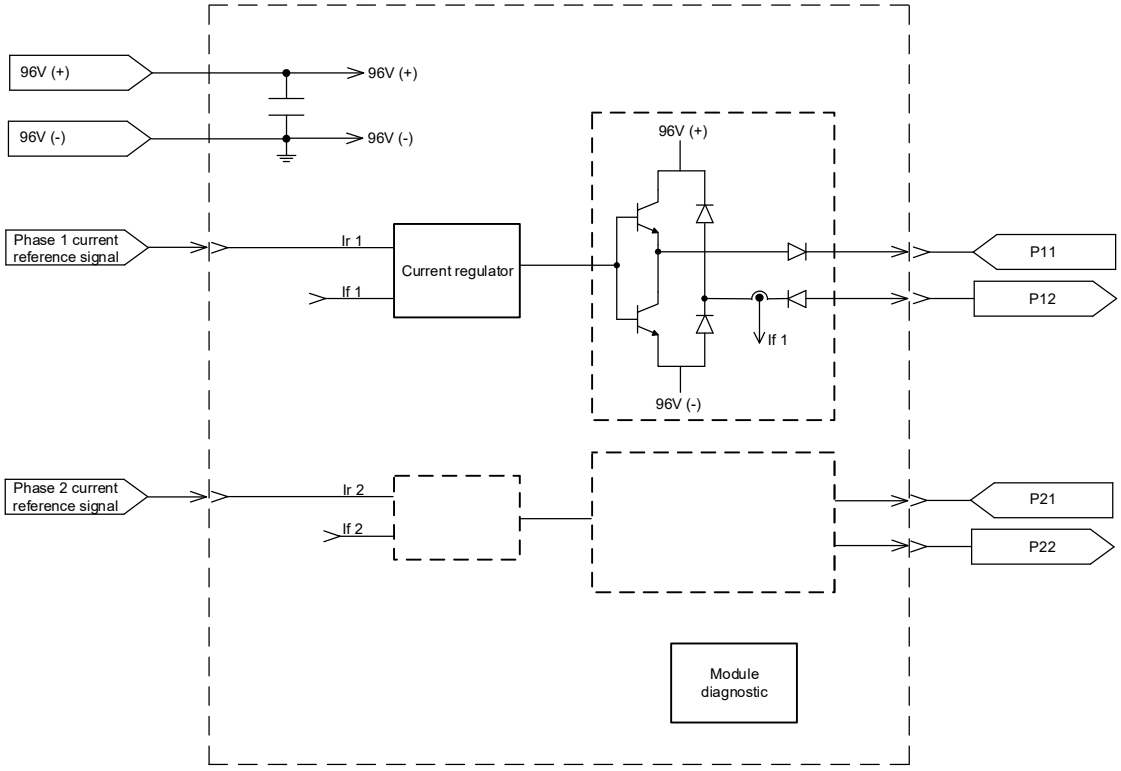


Figure 7 is block schematic of power module. Power module is 12T module. Each power module receives two Nos. of current reference signals from control module, 96 Volts DC power and produces pulse width modulated voltage to regulate current as per input current reference signal for two phases of the connected motor load. Module shall have module diagnostic circuit. Design data – electrical schematic, Bill of Material and PCB layout – of module is given in Annexure II.

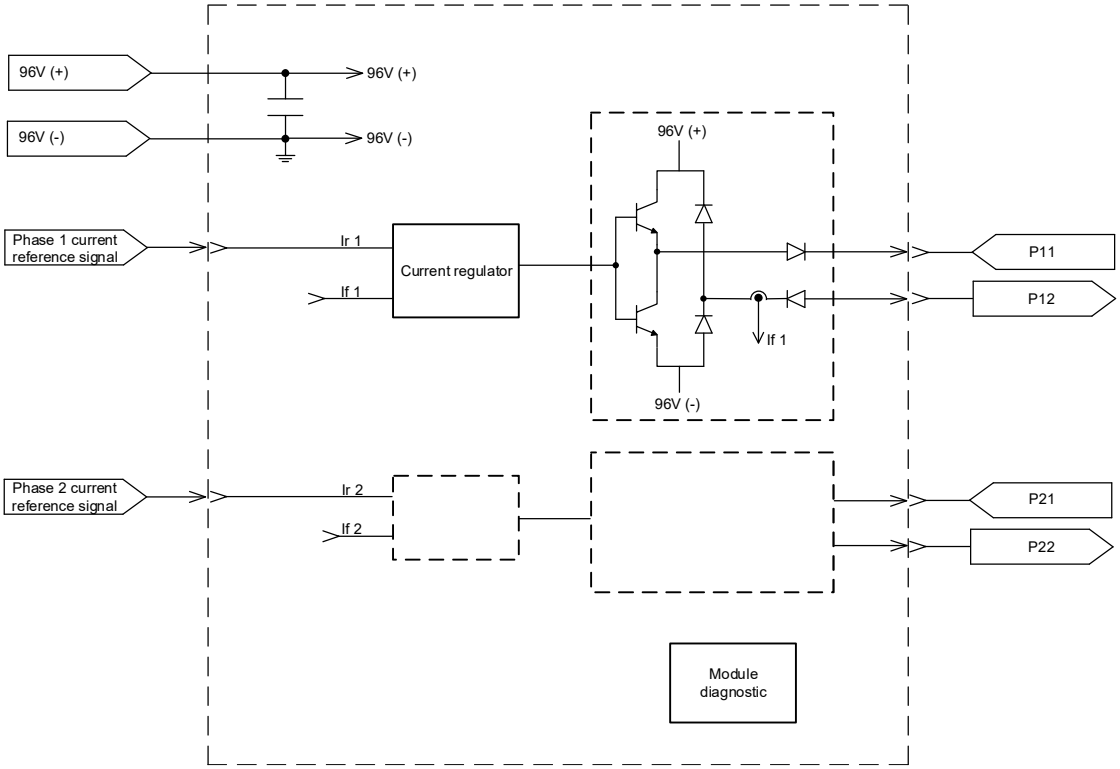


Figure 7: Block schematic of power module

3.5. Command Control Module:

Figure 8 is block schematic of command control module. Command control module is 5T module. The module receives 12V DC, Up commands, Down commands, TRIP and Limit Switch contact and generates motor direction signals to control module. Module shall have module diagnostic circuit. Design data – electrical schematic, Bill of Material and PCB layout – of module is given in Annexure II.

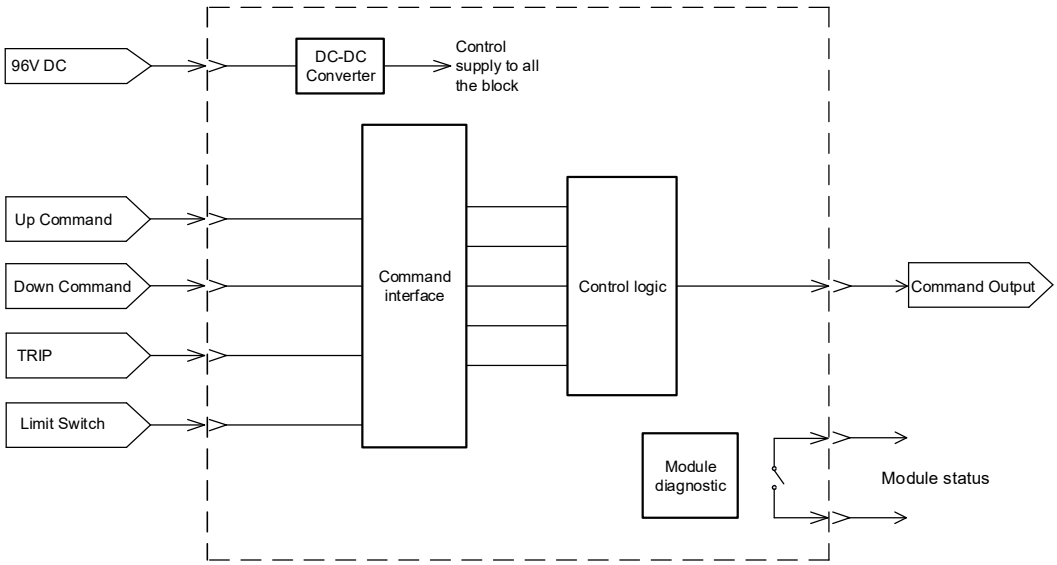


Figure 8: Block schematic of command control module

3.6. DC link capacitor plate:

DC link capacitors are used to filter out power supply ripples and smooth out 96V DC. Design data – electrical schematic, Bill of Material and PCB layout – of DC link capacitor is given in Annexure II.

4. Design Features:

i. All the DC-DC convertors required shall be of economical grade DC-DC convertor modules, high wattage from M/s VICOR or equivalent and low wattage (2W to 10W) from M/s GAIA or equivalent.
ii. Supplier shall used high reliability relays, relay part no. MGAP-5 or ER114-5 or 172-5 or equivalent.
iii. All the material used shall be brand new from reputed manufacturers procured from their authorized agents.
iv. All the ICs used shall be industrial grade or better.
v. Micro-processors, micro-controllers shall not be used in the system for logic and interlock except control command module. These shall be implemented using CMOS, TTL logic gates, analog ICs and relays.
vi. The system shall be modular in construction and the modules shall be pluggable using male/female connectors for ease of repair.
vii. All wires used shall be Teflon insulated with sufficient voltage/current margins.
viii. All the PCBs shall be fabricated using 70 micron copper clad board. The PCBs shall have green masking on both sides with legend print on component side. Wired PCBs shall have conformal coating on both sides.
ix. All the resistors shall have wattage safety margin of 2.5. Metal film resistors (MFR) shall be used. Wire wound resistor, CFR or any other type resistor shall be used only if use of MFR is not feasible.
x. All electrolytic capacitors shall have temperature rating of 85^0 C or more.
xi. The workmanship shall be in accordance with the high-grade practice to be satisfactory compliance to this specification.
xii. The control power supplies (5V, 12V etc.) required in motor control system shall be derived from isolated DC-DC convertors. These convertors shall form part of the motor control system.
xiii. Transformers and chokes shall be procured from reputed manufactures and shall be tested as per relevant IS standards.
xiv. Raw materials such as bars, angles, sheets, wires, etc. shall be procured from reputed manufacturers.

5. Procedure and stage by stage execution plan:

The supplier shall execute the job in the following manner.

i. The purchaser shall provide the detailed drawing - electrical circuit diagrams, PCB artwork Gerber data, mechanical drawings, bill of material with their detailed specification, test procedure etc. based on the requirement of each and every module of motor control system to the supplier for manufacturing.

ii. To maintain the quality and uniformity of product, supplier shall procure all the material required for motor control system along with spare components in one lot. The supplier shall fabricate all modules and assemble motor control system as per given design and test them thoroughly for confirmation of meeting the requirements.

The supplier shall offer motor control system along with test report to the purchaser for shipping release.

iii. The supplier shall supply complete motor control system along with spare components as per work order along with test reports after shipping release.

6. Delivery schedule

i. Supplier shall execute and supply all items listed in the scope of supply of this minor fabrication within six months from the date of firm work order placed on the supplier.

ii. Any delay which is attributable to contractor is liable for penalty at 0.5% per week to be imposed on the supplier subjected to maximum of 5%. In case extension of delivery period is required, supplier should request for delivery period extension well before expiry of delivery period.

7. Acceptance

Acceptance of the equipment shall be subject to its meeting the specifications and fulfillment of various requirements covered in this document. Equipment shall be shipped only after a shipping release is issued by an authorized representative of purchaser.

8. Warrantee

Supplier shall provide a warranty for all items under the scope of supply stated in Minor Fabrication for the period of 12 Months from the date of acceptance by purchaser.

9. General terms and conditions

i. Quality surveillance, inspection:

All work covered by the specification shall be subject to quality surveillance/ inspection by the purchase or his authorized representative. No Insurance policy is required for the free issue material as the job is done in house.

ii. Sub-Contract:
The supplier shall not sub-contract any or all of the work without written consent from the purchase. The supplier shall be responsible for the inspection of the components that is sub-contracted by him.

iii. Payment:
Payment will be made only after satisfactory completion of work and against submission of original bill in-triplicate and advance stamped receipt.

iv. Tax:
Income-Tax will be deducted from the payments made to the Supplier as per Income Tax rules. Supplier may claim exemption, if any.

v. GST:
Purchaser shall issue certificate to avail CGST 2.5% of invoice and SGST 2.5% of invoice in case of intrastate supply of goods **OR** IGST 5% of invoice in case of interstate supply of goods.

vi. Confidentiality:

No party shall disclose any information to any third party concerning the matters under this contract generally. In particular, any information identified as "Proprietary" in nature by disclosing party shall be kept strictly confidential by the receiving party and shall not be disclosed to any third party without the prior written consent of the original disclosing party.

This clause shall apply to sub-contractors, consultants, advisors or the employees engaged by a party with equal force.

"Restricted information" categories under section 18 of the Atomic Energy Act, 1962 and "Official Secrets" under Section 5 of the Official Secrets Act, 1923:

Any contravention of the above mentioned provisions by any contractor, sub-contractor, consultant, advisor or the employees of the contractor will invite penal consequences under the aforesaid legislation.

Prohibition against use of BARC's name without permission for publicity purpose:

The contractor or sub-contractor, consultant, advisor or the employees engaged by the contractor shall not use BARC’s name for any publicity purpose through any public media like Press, Radio, T.V. or Internet without the prior written approval of BARC

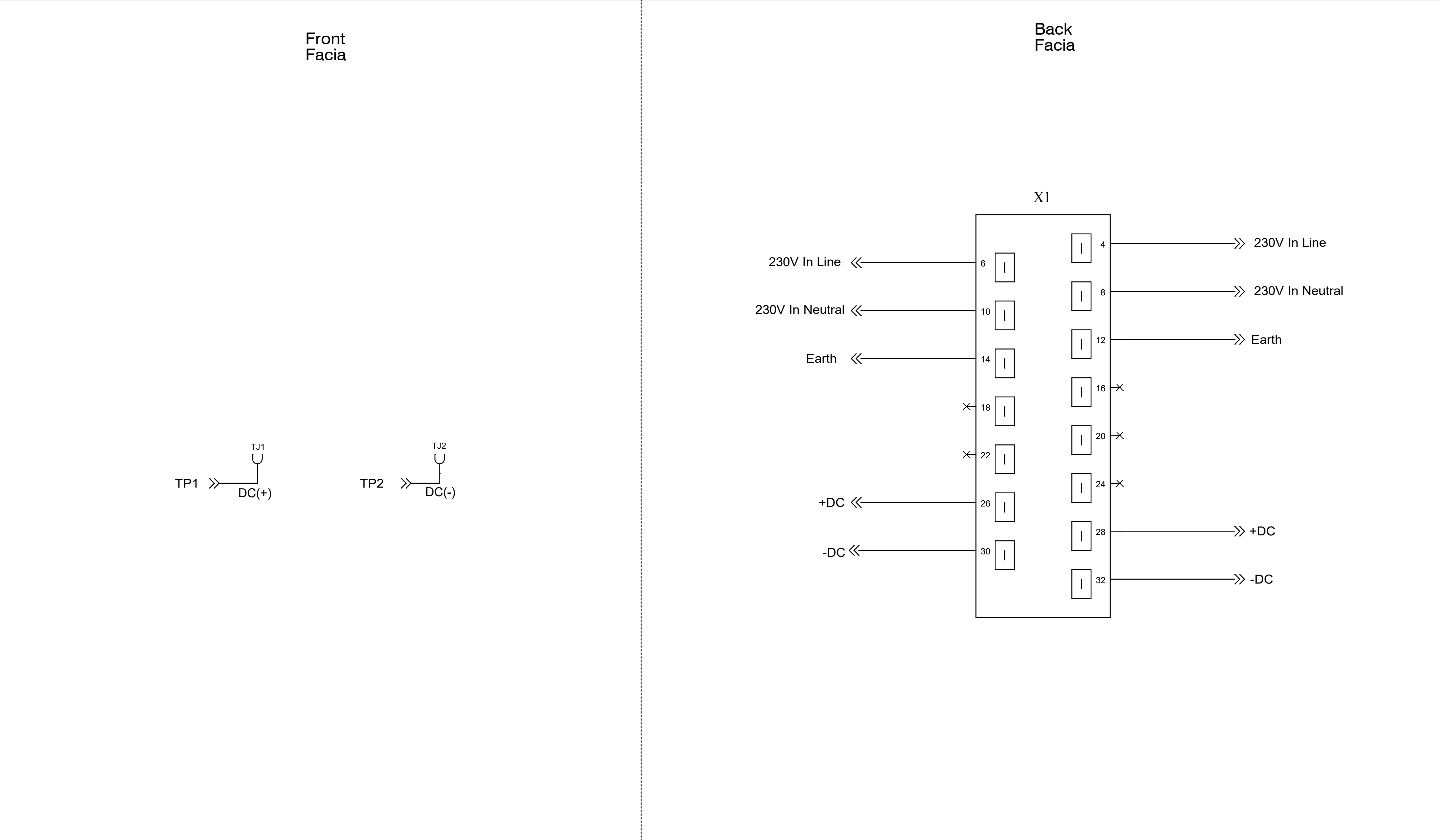
(Head, CnID)

Annexure II

Index

1. Rectifier module
2. PS96 V PS
3. Control module
4. Power module
5. Control command module
6. DC link capacitor plate

1. Rectifiers module



No.	LOC	REVISION DESCRIPTION	DRN DATE	APPD

REFERENCE DRAWINGS

TITLE	DRG.No.
GENERAL ARRANGEMENT	
BILL OF MATERIAL	

SCALE: PROJECTION

ALL DIMENSIONS ARE IN mm UNLESS STATED
OTHERWISE GENERAL TOLERANCE ANGLES ± 1/2°
FULL NOS. ±1 1 DEC.PLACE ±0.5
2 DEC.PLACE ±0.05 3 DEC.PLACE ±0.005

ISSUE NO.	REV NO.	ISSUED FOR	PROJ.No.	ISSUE SHT.No.	DATE	APPD.

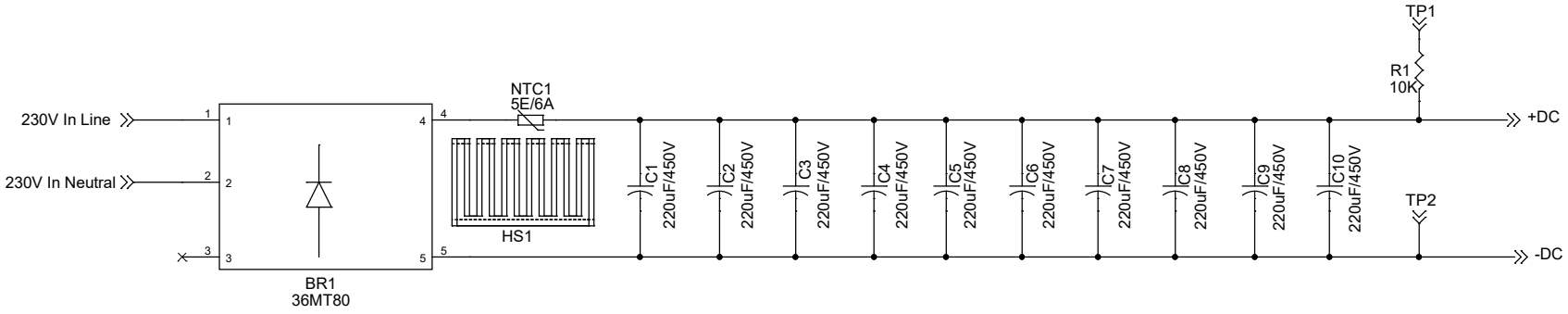
TITLE **Reactifier Module**
ELECTRICAL SCHEMATIC

DRN	DRG. CHKD.	DES.	DES. CHKD.	APPD.
				PROJ. NO.

CUST DRG No.

SHT. 1 OF 2
REV. 0

DRG.NO.
SHT. 1 OF 2
REV.



SUB TITLE	TITLE Reactifier Module ELECTRICAL SCHEMATIC			DRG. No.
	DRN	DRG. CHKD.	DES. CHKD.	SHT. 2 OF 2
			CUST DRG No.	REV. 0

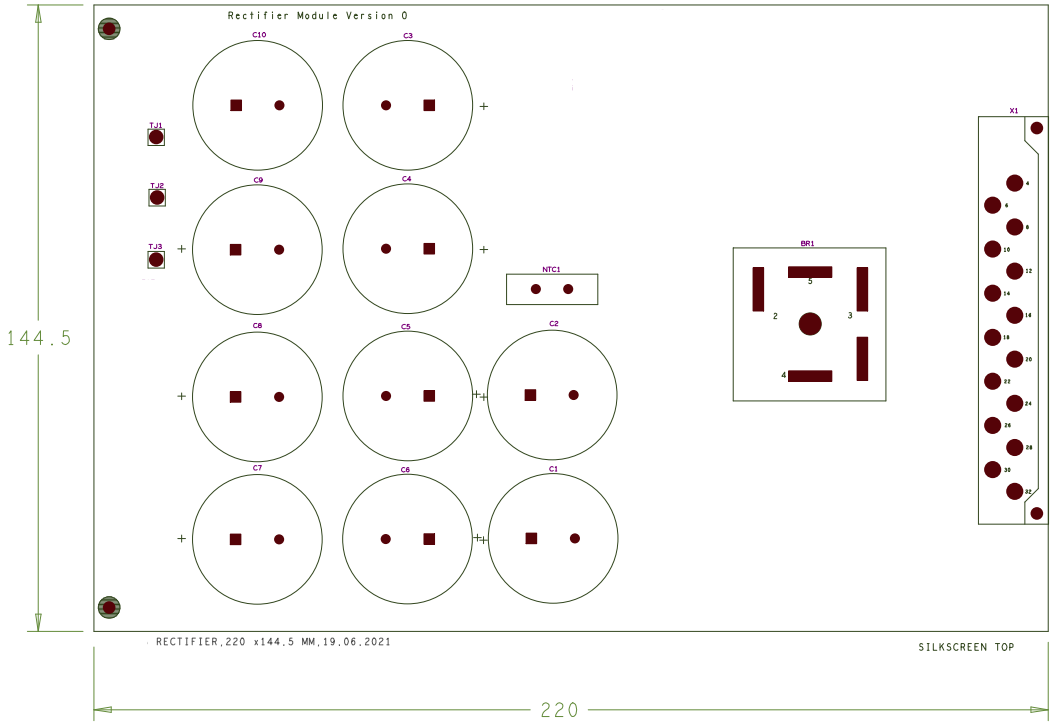
REV. NO.	DATE	REVISIONS / ISSUES	PREPARED	APPROVED
0		ISSUED FOR APPROVAL		

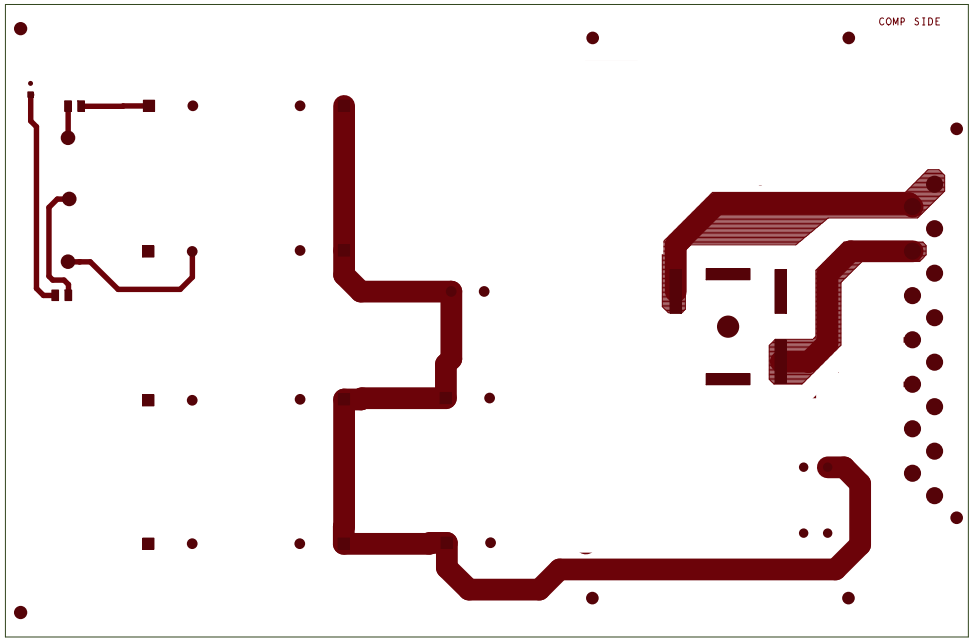
REFERENCE CL	**REACTIFIER MODULE** BILL OF MATERIAL	
DATE PREPD CHKD APPD	IDAPL	PROJ. NO. **BM-** SHT. 1 OF 2 REV. 0

BM-

ITEM NO.	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./ DRG. NO./ MAKE&TYPE	REMARKS	proc. REF.
1	PRINTED CIRCUIT BOARD	PCB1	1			
2	Diode Bridge	BR1	1	Vishay 36MT80 , D-63 package		
3	Electrolytic Capacitor 220uF/450V, 20%,Axial: 30mm X 35mm	C1-C10	10	Nichicon LGUW6221MELB		
4	NTC 4.5E/6A	NTC1	1	EPCOS B57236S0509M054		
5	Test Point	TP1,TP2	2	Mittal Electronics ME-47		
6	Connector H15 MALE Connector (15 pin)	X1	1	HARTING 09061152921		

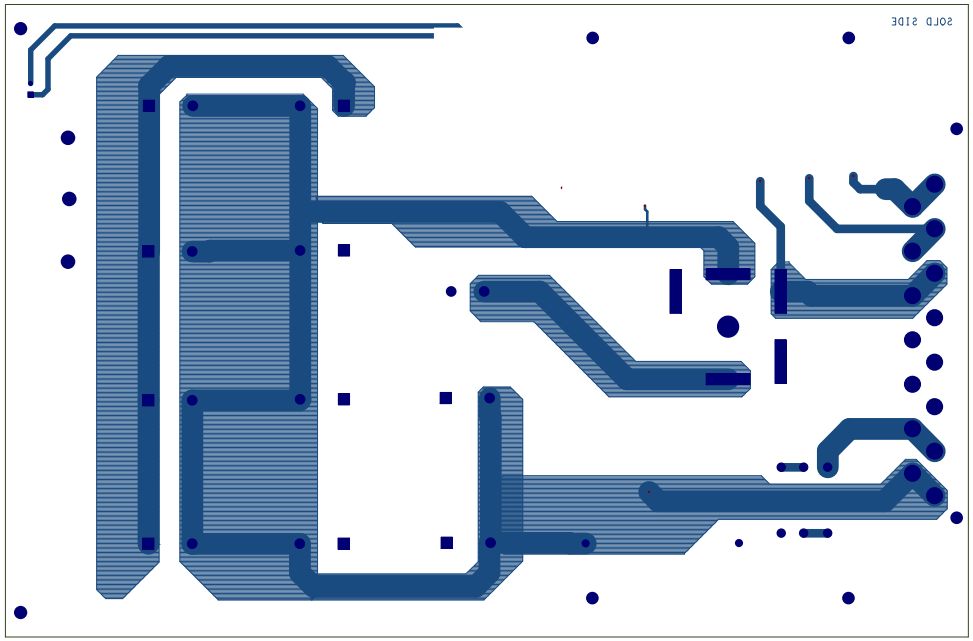
DRN	CHKD	APPD	CUST. REF.	BM-
				SHT. 2 OF 2
				REV. 0


Rectifier Module Version 0
C10
C3
TJ1
TJ2
C9
C4
TJ3
NTC1
BR1
X1
C8
C5
C2
C7
C6
C1
144.5
220
RECTIFIER,220 x144.5 MM,19.06.2021
SILKSCREEN TOP



RECTIFIER,220 x144.5 MM,19.06.2021

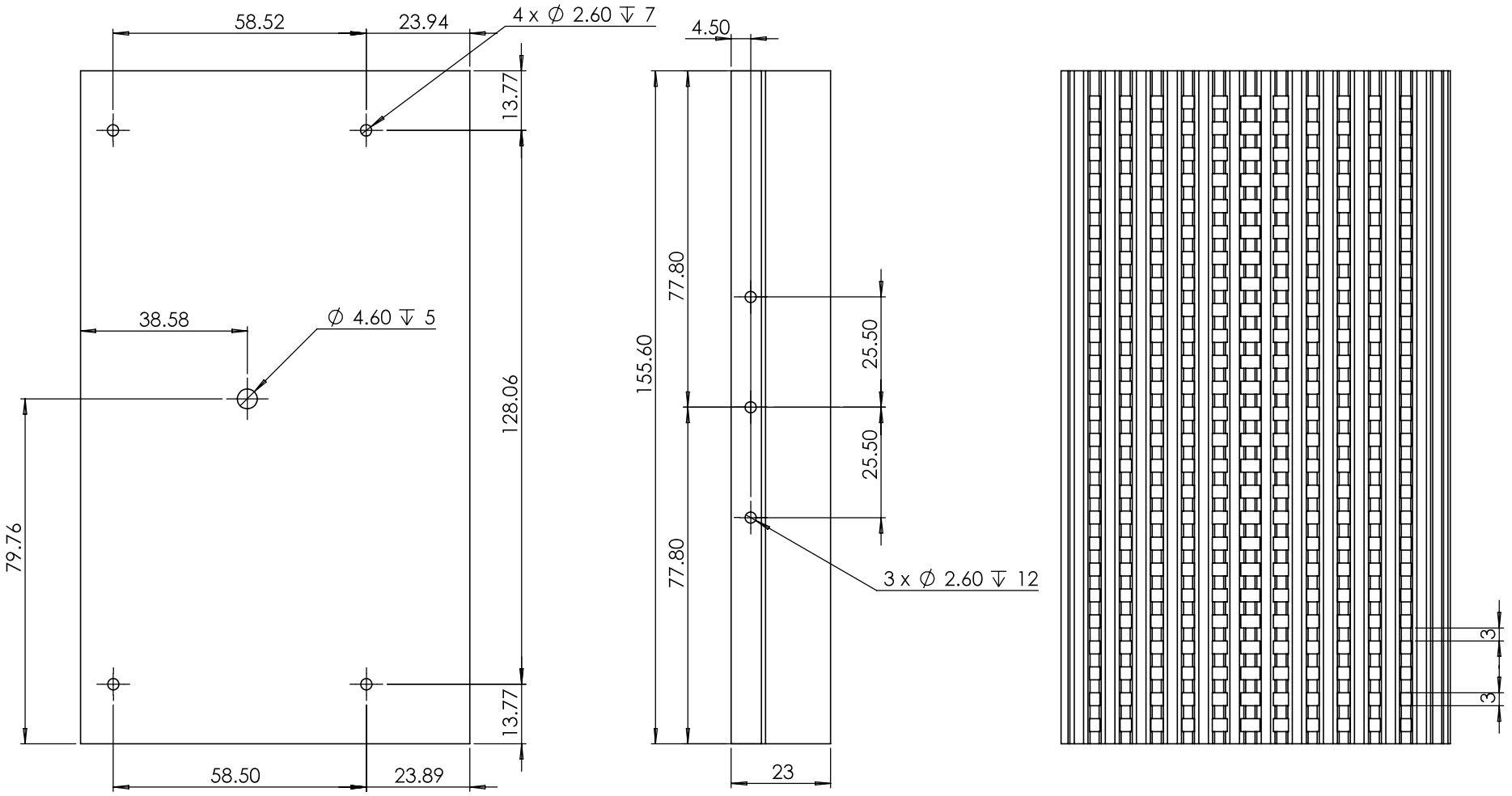
L1-TOP

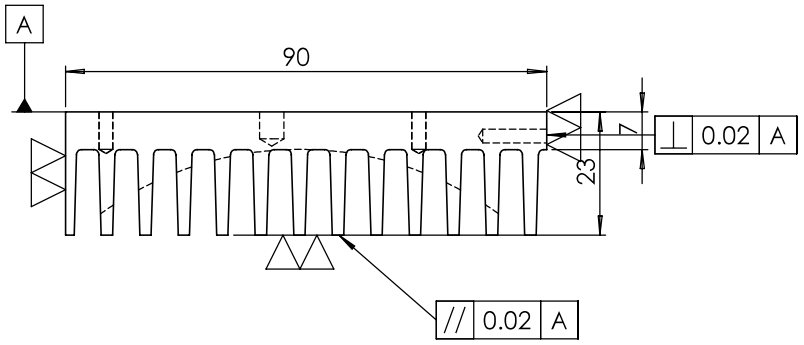


RECTIFIER,220 x144.5 MM,19.06.2021

L2-BOTTOM

DRILL CHART: TOP to BOTTOM				
ALL UNITS ARE IN MILLIMETERS				
FIGURE	FINISHED_SIZE	ROTATION	PLATED	QTY
	0.35	-	PLATED	21
	0.6	-	PLATED	2
	1.0	-	PLATED	10
	1.2	-	PLATED	6
	1.4	-	PLATED	12
	1.5	-	PLATED	10
	1.7	-	PLATED	15
	2.0	-	PLATED	3
	3.0	-	PLATED	12
	5.2	-	PLATED	1
	7.0x1.0	90.000	PLATED	3
	7.0x1.0	0.000	PLATED	2



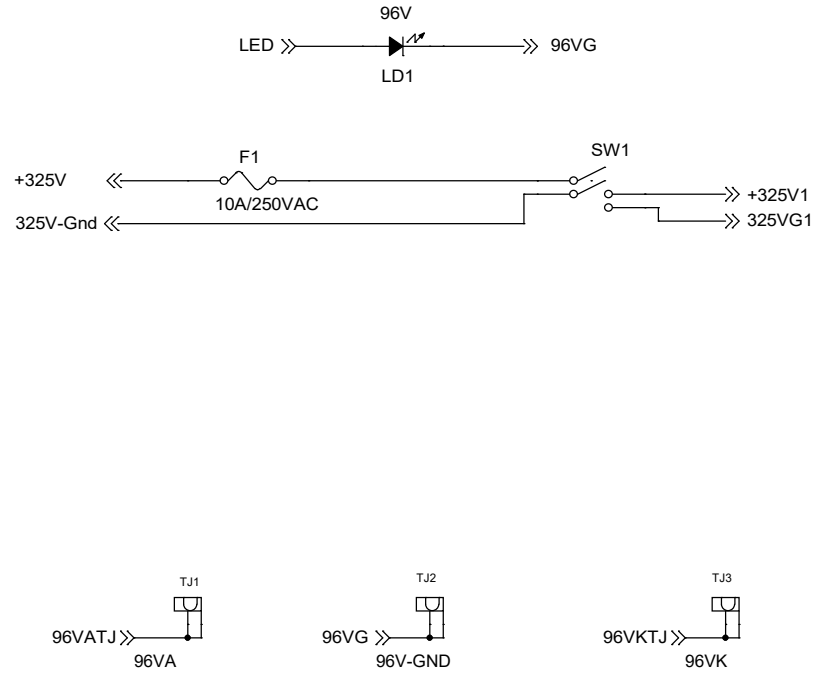


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:		DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION 1.1	
	NAME	SIGNATURE	DATE		TITLE: Rectifier Module Heat Sink		
DRAWN			10/00/20				
CHK'D							
APPV'D							
MFG							
Q.A	1 NOS			MATERIAL: AL	DWG NO.	A3	
				WEIGHT: 156.26	SCALE:1:2	SHEET 1 OF 1	

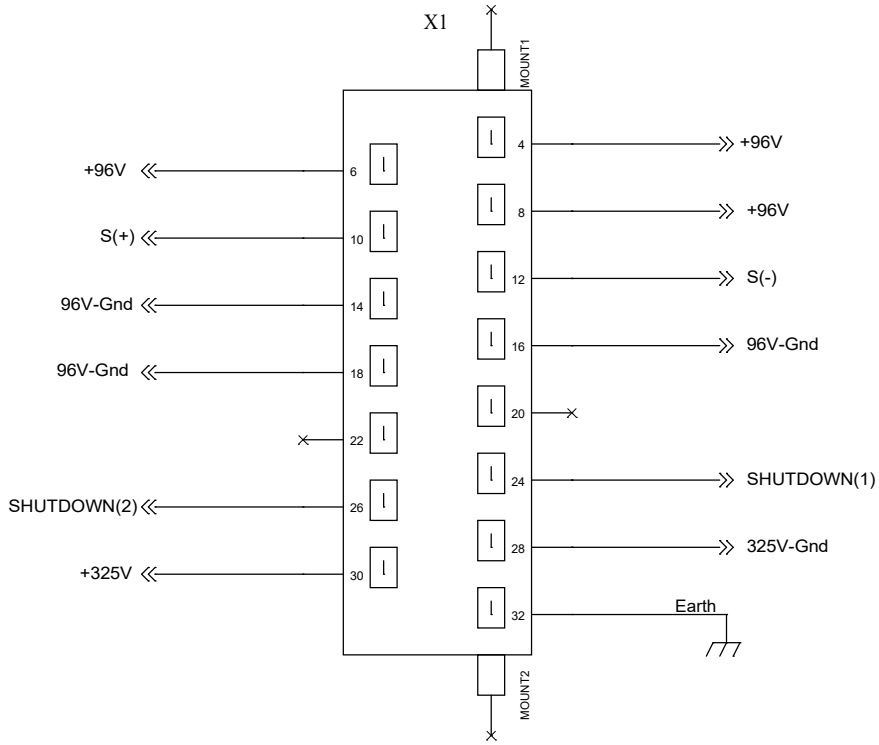
2. PS96 V PS

DRG.NO. SHT. 1 OF 2 REV. 0

Front Facia



Back Facia



No.	LOC	REVISION DESCRIPTION	DRN DATE	APPD

GENERAL ARRANGEMENT

BILL OF MATERIAL

TITLE	DRG.No.

REFERENCE DRAWINGS

SCALE: PROJECTION

ALL DIMENSIONS ARE IN mm UNLESS STATED
OTHERWISE GENERAL TOLERANCE ANGLES ± 1/2°
FULL NOS. ±1 1 DEC.PLACE ±0.5
2 DEC.PLACE ±0.05 3 DEC.PLACE ±0.005

ISSUE NO.	REV NO.	ISSUED FOR	PROJ.No.	ISSUE SHT.No.	DATE	APPD.

TITLE : 96V PS
ELECTRICAL SCHEMATIC

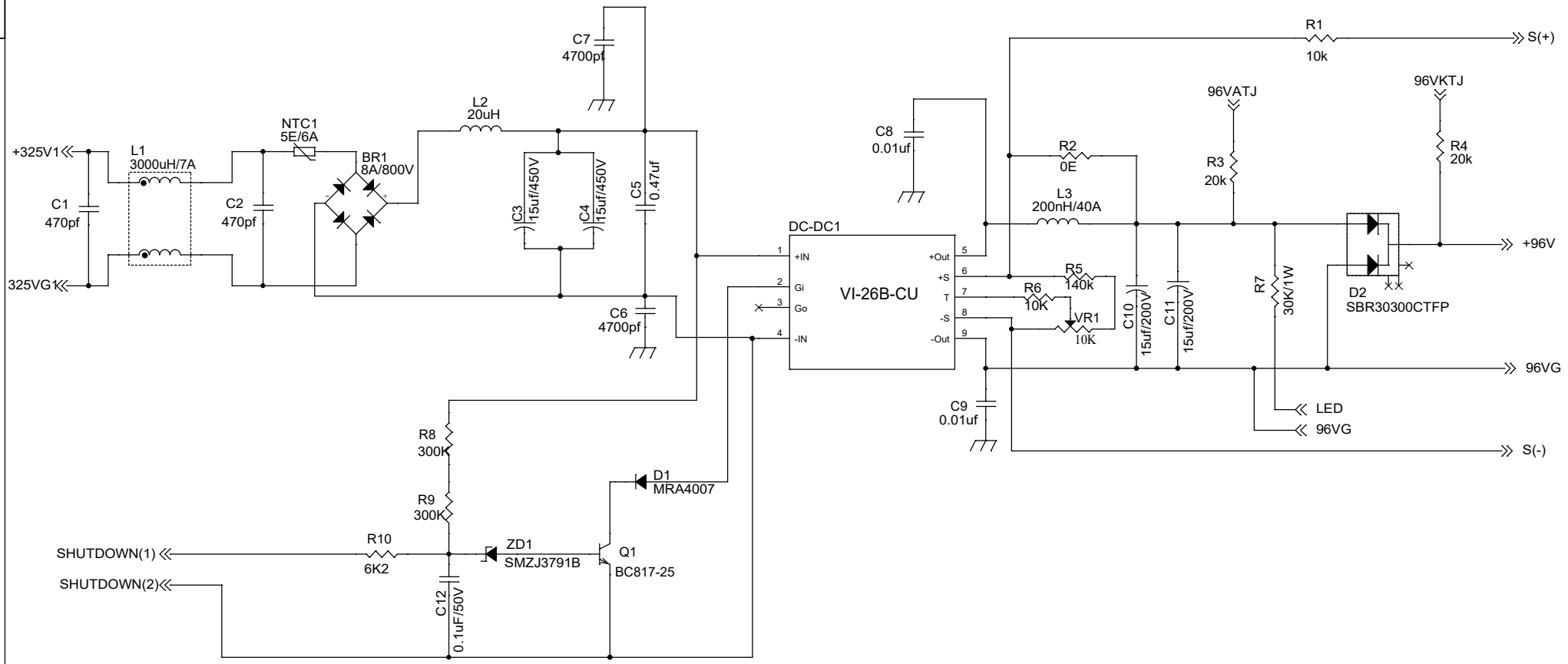
DRN		DES.	DES. CHKD.	APPD.

PROJ. NO.

SHT. 1 OF 2 A

CUST DRG No.

REV. 0



HEATSINK MOUNTING HOLES

A	SUB TITLE		TITLE 96V PS ELECTRICAL SCHEMATIC				DRG. No. A	
			DRN	DRG. CHKD.	DES. CHKD.		SHT. 2 OF 2	
						CUST DRG No.	REV. 0	
8	7	6	5	4	3	2	1	

REV. NO.	DATE	REVISIONS / ISSUES	PREPARED	APPROVED
0		ISSUED FOR APPROVAL		

REFERENCE CL	**96 V PS** BILL OF MATERIAL	
DATE PREPD CHKD APPD		PROJ. NO. **BM-** SHT. 1 OF 3 REV. 0

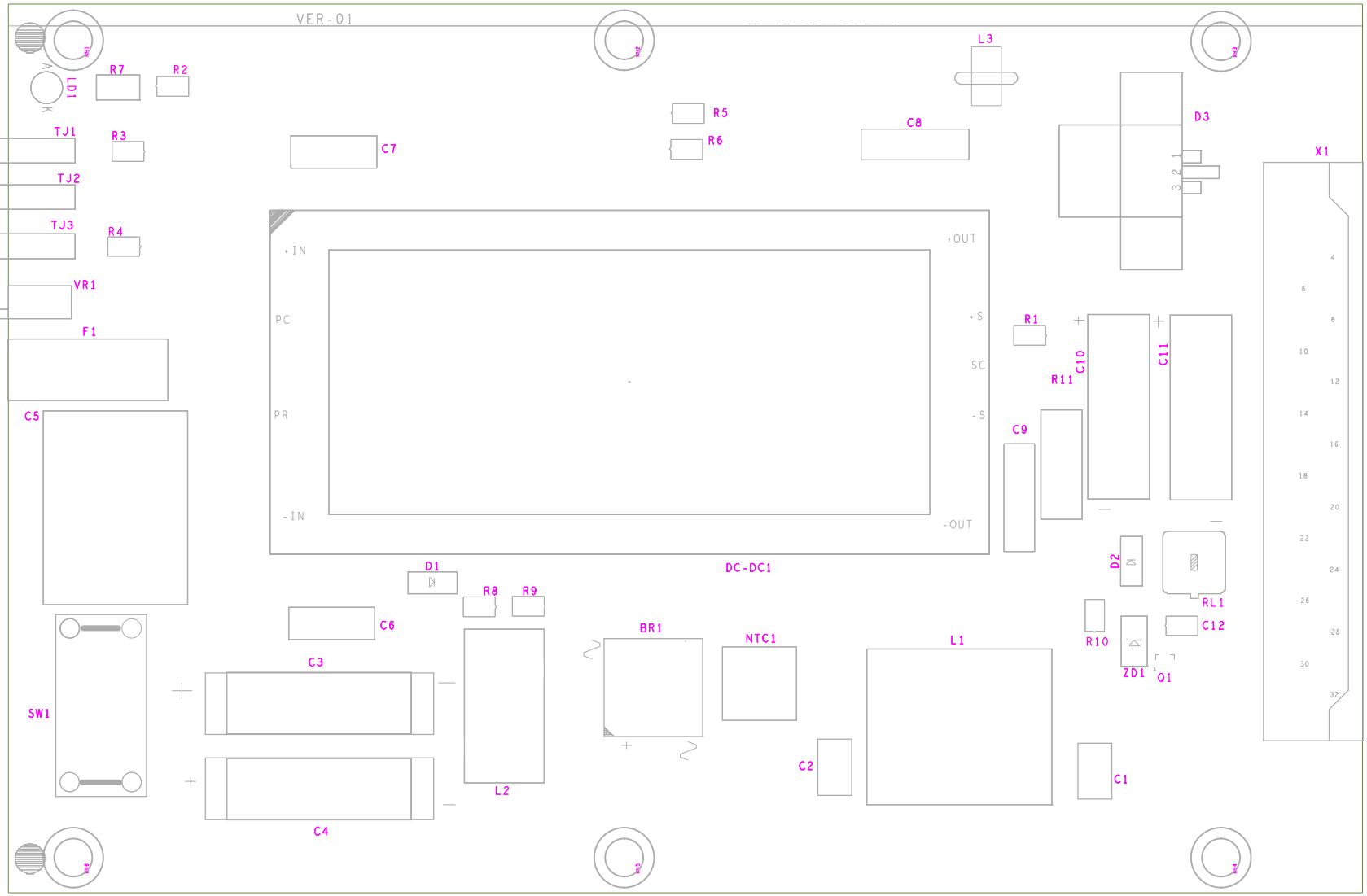
BM-

ITEM NO.	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./ DRG. NO./ MAKE&TYPE	Remarks	PROC. REF.
1	PRINTED CIRCUIT BOARD	PCB1	1			
2	1-Phase diode Bridge - 8A / 800 V	BR1	1	WTE Electronics KBPC808		
3	MPPC Capacitor-470 pf / 2 KV 7.5 mm Pitch	C1,C2	2	VISHAY S471K29X7RP63K5R		
4	Electrolytic Capacitor- 15uf /450V, 20% Axial (10X30mm)	C3, C4, C10, C11	4	VISHAY MAL211892159E3		
4	Electrolytic Capacitor- 15uf /450V, 20% Axial (10X30mm)	C3, C4, C10, C11	4	VISHAY MAL211892159E3		
5	X-Capacitor- 0.47 uf / 250 VAC	C5	1	Vishay F17724472030		
6	Y- Capacitor- 4700pf /250 VAC	C6, C7	2	KEMET P271HL472M250CR06		
7	Y- Capacitor- 0.01uf /250 Vac	C8, C9	2	Vishay F1710-310-1000		
8	Capacitor 0.1uf/50V,10%,SMD: 1206	C12	1	Vishay VJ1206Y104KXAAT		
9	Diode Package: ITO220AB	D2	1	DIODE incorporation SBR30300CTFP		
10	Diode SMD: DO-214AC package	D1	2	On Semi MRA4007T3G		
11	DC-DC Converter Input 300VDC, O/p 95VDC, 200W	DC-DC1	1	Vicor VI-26B-CU		
12	Fuse holder along with fuse of -	F1	1 set	Schurter 31.3558		
13	Common Mode Choke - 3000uH / 7A	L1	1	Vicor 31742		
14	Differential Choke -20uH/10A	L2	1	Vicor 33206		
15	Differential Filter Choke - 200 nH /40A	L3	1	Vicor 30268		
16	Light Emitting Diode Dia-3mm,pitch-2.54, green	LD1	1			

	DRN	CHKD	APPD	CUST. REF.		BM-
						SHT. 2 OF 3
						REV. 0

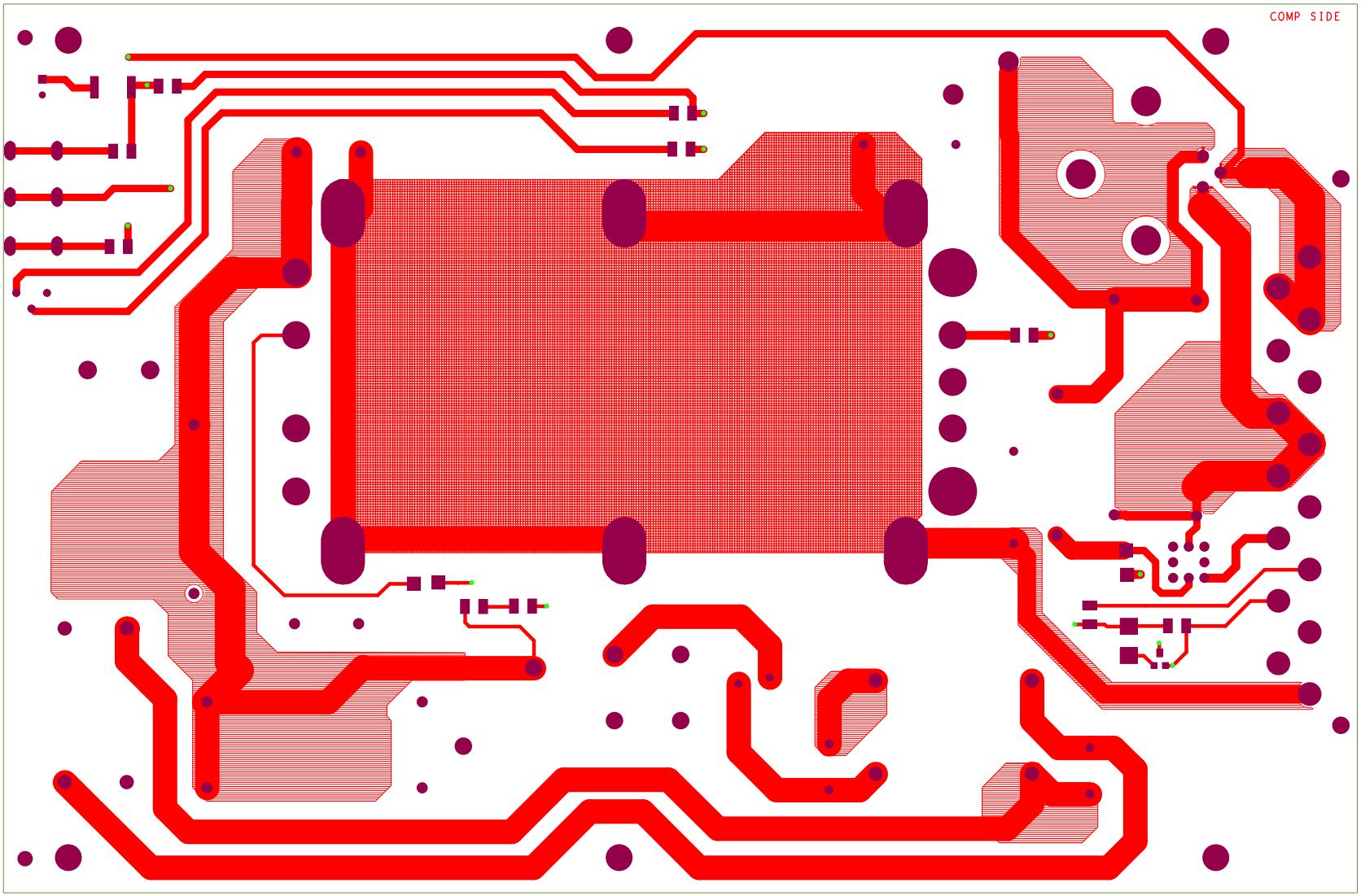
ITEM NO.	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./ DRG. NO./ MAKE&TYPE	Remarks	PROC. REF.
17	NTC: 5 E/6A	NTC1	1	EPCOS B57236S0509M0		
18	Transistor	Q1	1	Diode Incorporation BC817-25 SOT23 Package		
19	RESISTOR 140K,0.25W, ±1% , SMD : 1206	R5	1	ROHM Semiconductor KTR18EZPF1403		
20	RESISTOR 10K,0.25W, ±1% ,SMD : 1206	R1,R2,R6	3	ROHM Semiconductor KTR18EZPF1002		
21	RESISTOR 20K,0.25W, ±1% , SMD : 1206	R3,R4	2	ROHM Semiconductor KTR18EZPF2002		
22	RESISTOR 30K,1W, ±1% ,SMD: 2512	R7	1	Vishay CRCW251230K0FKEG		
23	RESISTOR 300K,0.25W, ±1% ,SMD : 1206	R8,R9	2	ROHM Semiconductor KTR18EZPF3003		
24	RESISTOR 6K2,0.25W,±1%,SMD : 1206	R10	1	ROHM Semiconductor KTR18EZPF6201		
26	Test Point - Red	TJ1, TJ2	2	Schurter 40.1012		
27	Test Point - Blue	TJ3	1	Schurter 40.1014		
28	DPST Switch - 10A / 250 V	SW1	1	Arcolectric H8550XBAAA		
29	10K,10 turn , right access, stagered	VR1	1	Bourns 3296Z-1-103		
30	Connector H15 MALE Connector(15 pin)	X1	1	HARTING 09061152921		
31	Connector H15 FEMALE Connector (15pin)	X2	1	HARTING 09062152811		
32	Zener Diode- 27V SMD:DO214AA	ZD1	1	Philips SMZJ3799B-e3/52		

	DRN	CHKD	APPD	CUST. REF.			BM-
							SHT. 3 OF 3 REV. 0



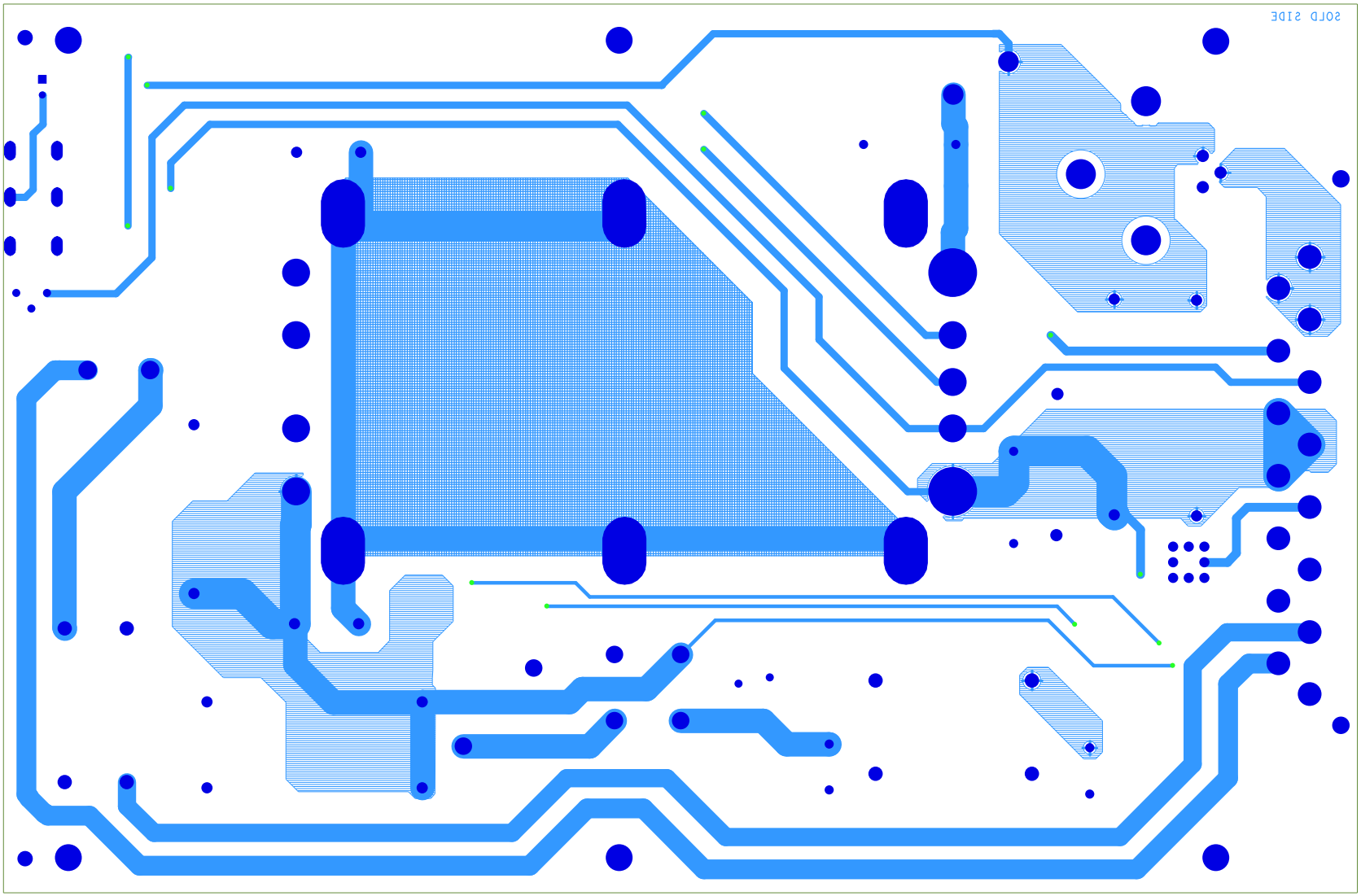
, 220 X 144.45, 10.12.2020.

SILKSCREEN TOP



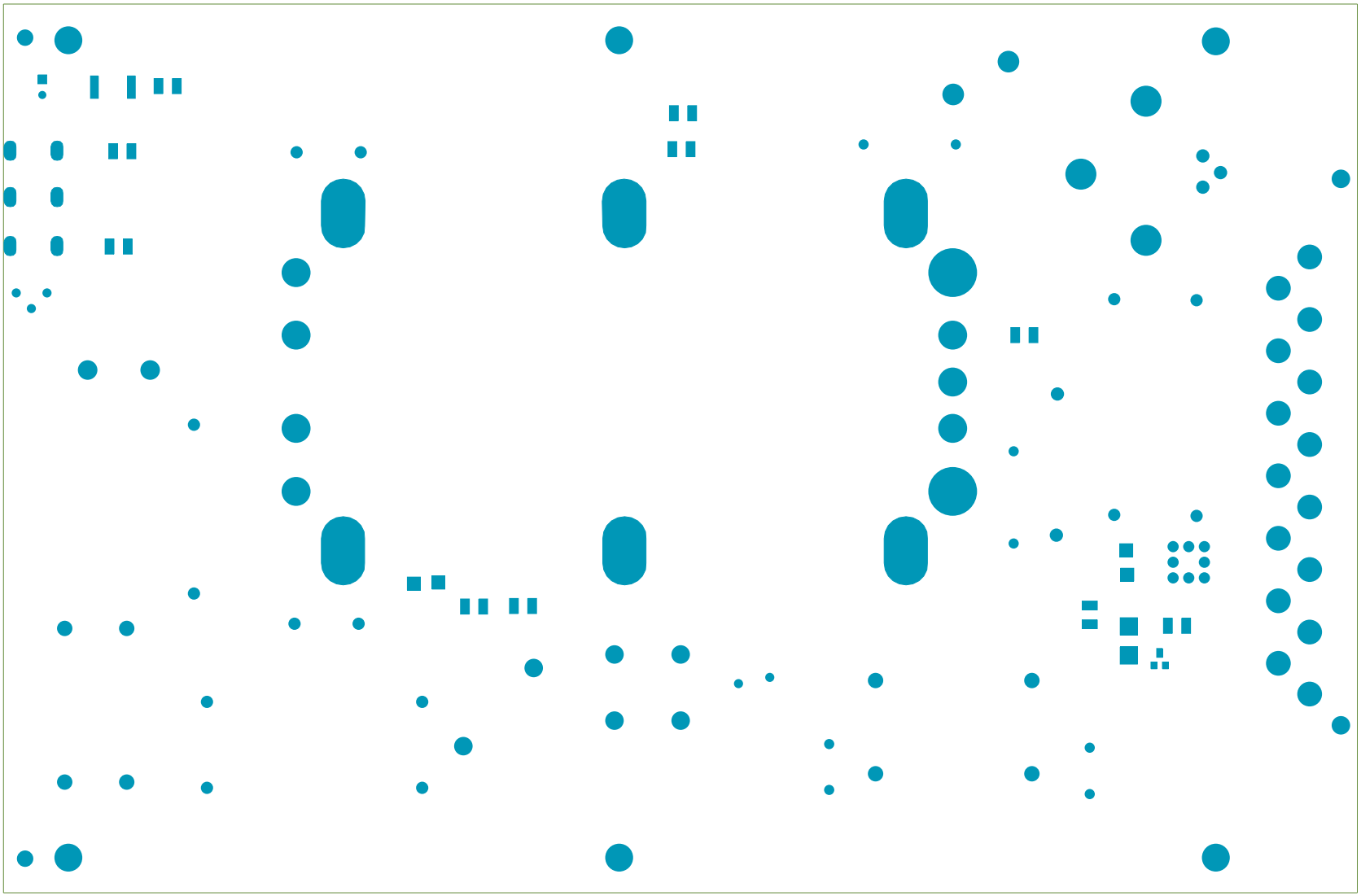
VER-01, 220 X 144.45, 10.12.2020.

L1-TOP



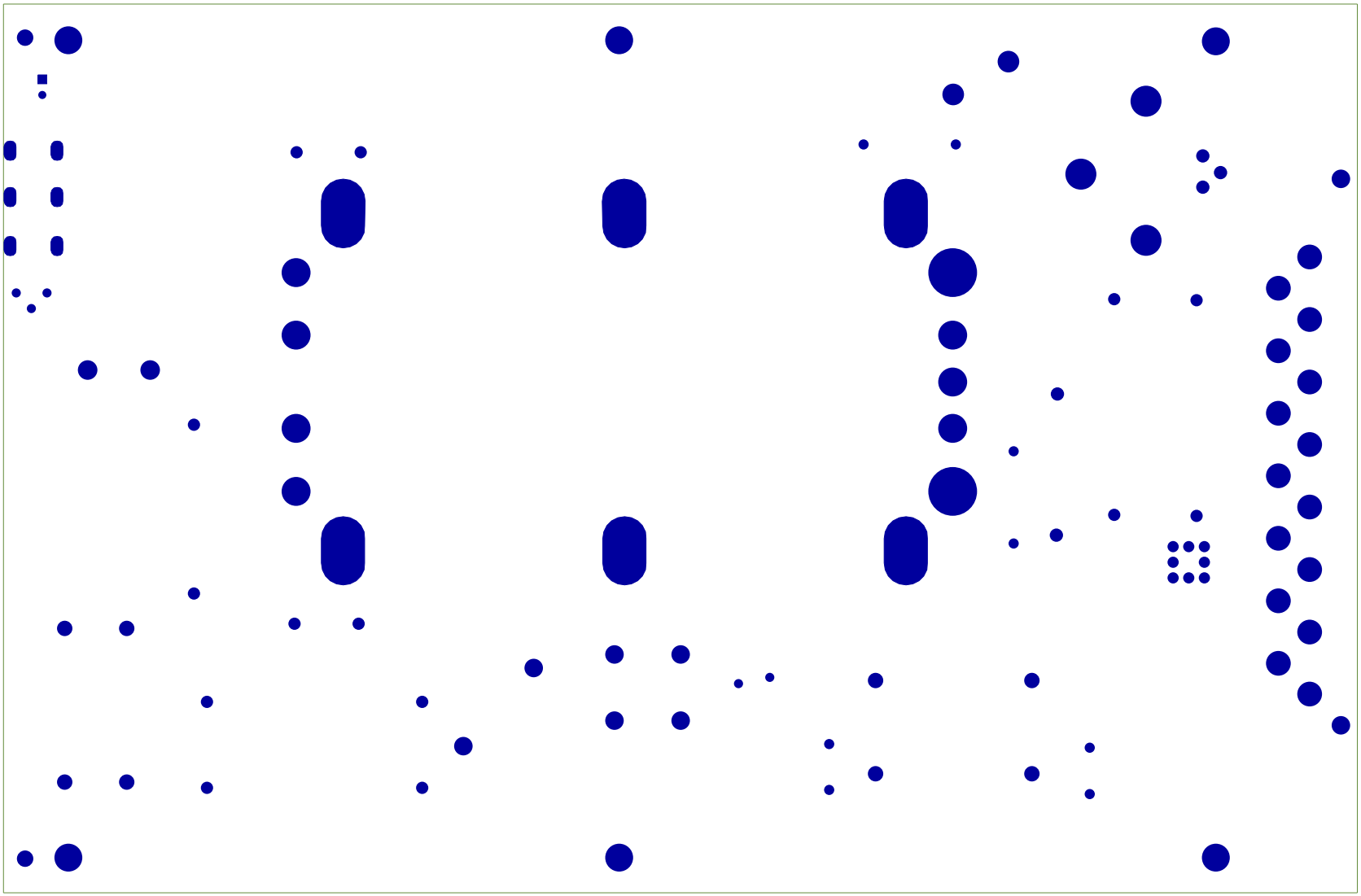
_VER-01, 220 X 144.45, 10.12.2020.

L2-BOTTOM



VER-01, 220 X 144.45, 10.12.2020.

SOLDER MASK TOP

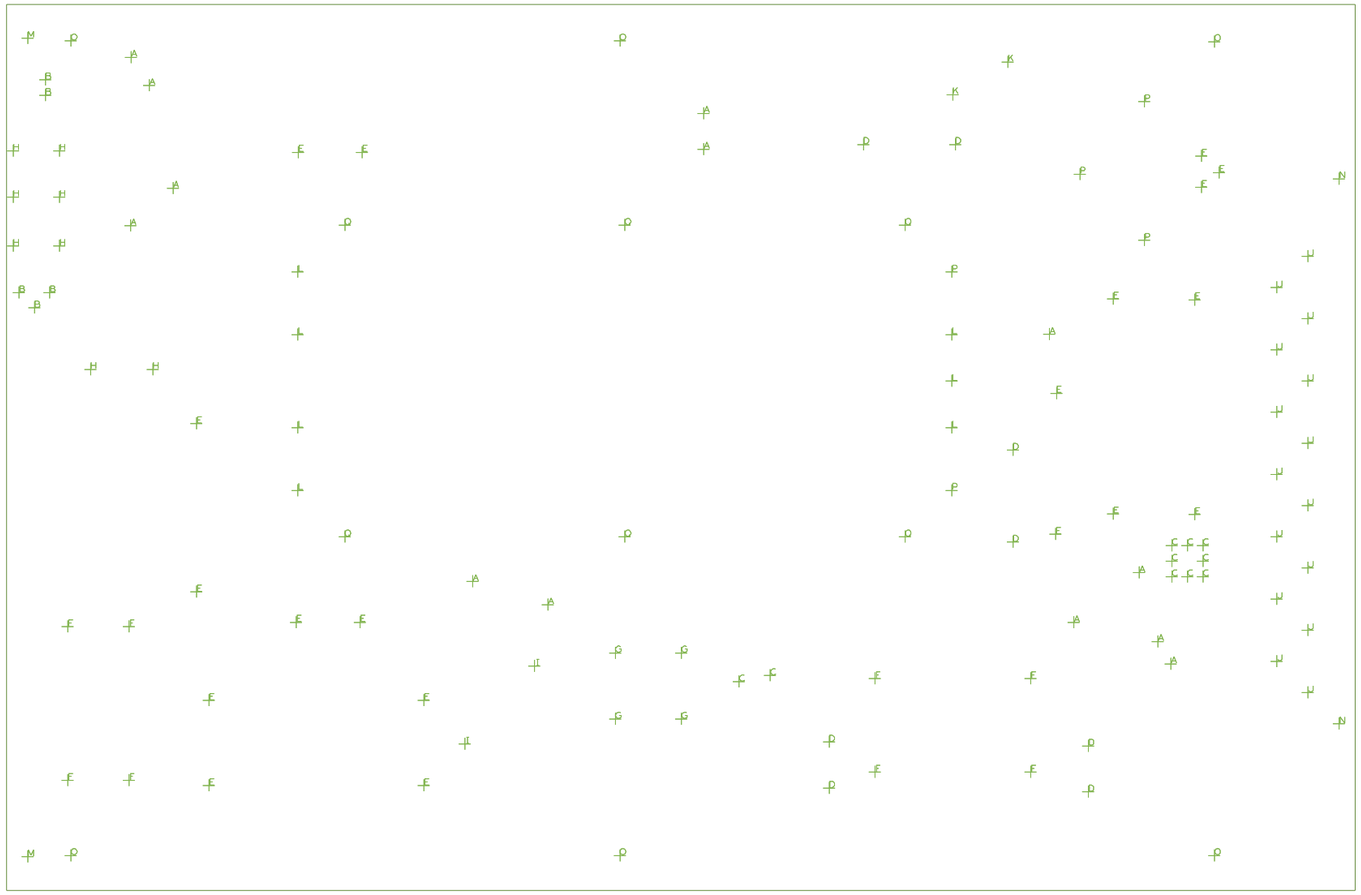


_VER-01, 220 X 144.45, 10.12.2020.

SOLDER MASK BOTTOM

PCB FAB DETAILS:

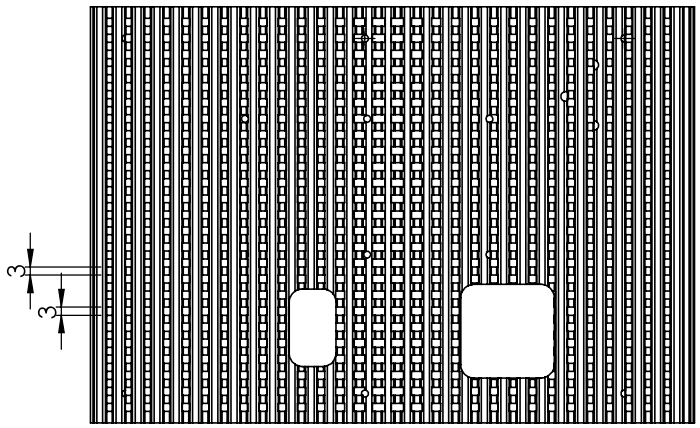
1. DOUBLE SIDE PCB
2. PCB MATERIAL : FR4 GLASS EPOXY
3. PCB THICKNESS 1.6 MM
4. COPPER THICKNES 70 MICRONS
5. TINNING ENIG
6. MASKING GREEN
7. ALL DIMENSIONS ARE IN MM

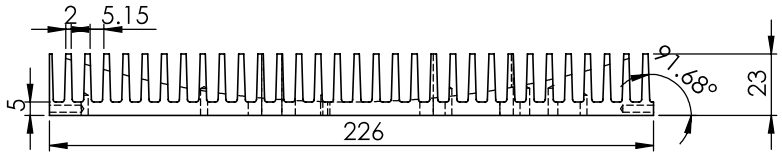


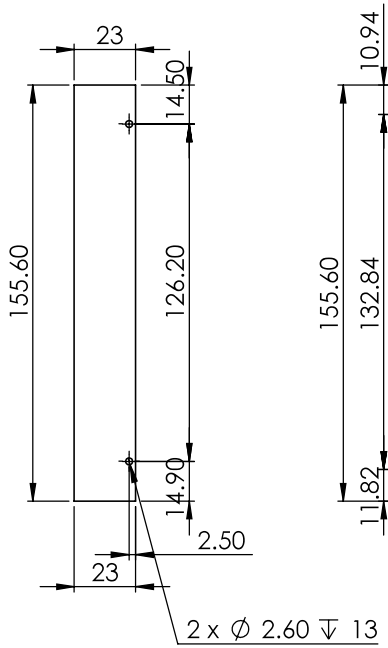
_VER-01, 220 X 144.45, 10.12.2020.

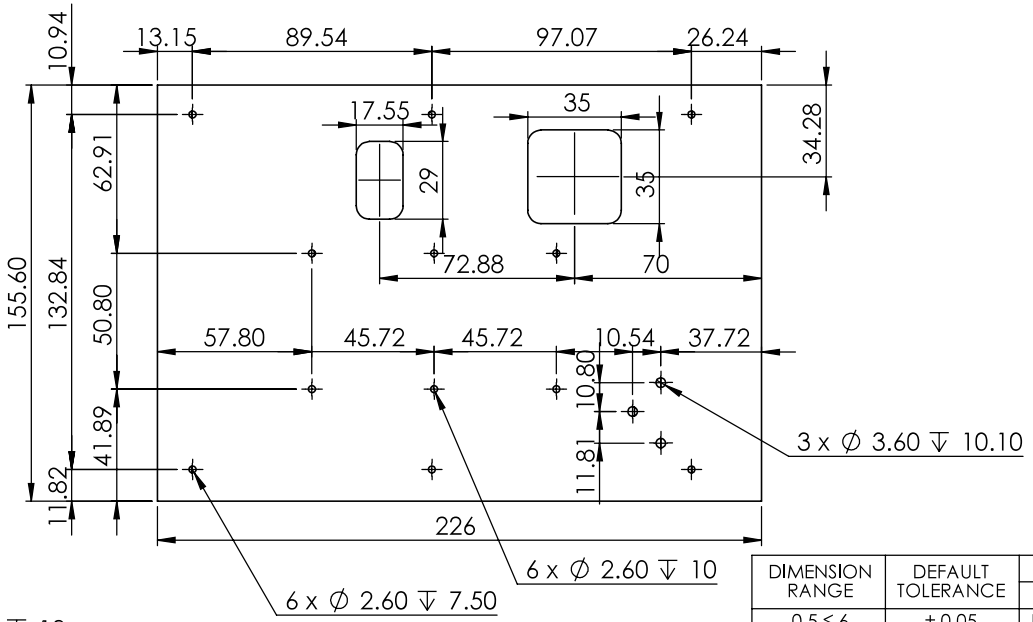
DRILL DRAWING

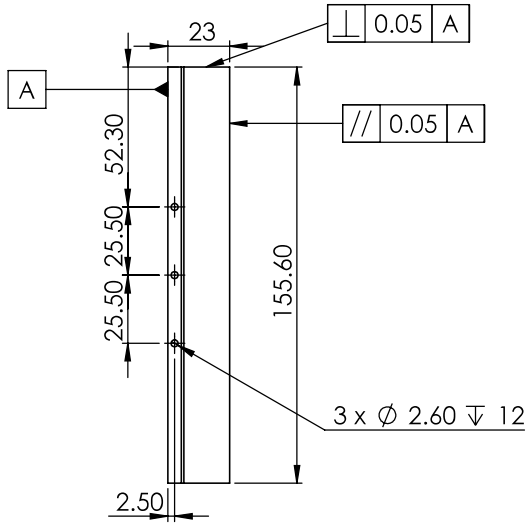
DRILL CHART: TOP to BOTTOM			
ALL UNITS ARE IN MILLIMETERS			
FIGURE	FINISHED_SIZE	PLATED	QTY
⌀	0.5	PLATED	13
⌀	0.6	PLATED	5
⌀	0.7	PLATED	10
⌀	0.8	PLATED	8
⌀	1.0	PLATED	19
⌀	1.2	PLATED	8
⌀	1.4	PLATED	4
⌀	1.5	PLATED	8
⌀	1.6	PLATED	2
⌀	1.7	PLATED	15
⌀	2.0	PLATED	2
⌀	2.5	PLATED	7
⌀	2.7	PLATED	2
⌀	3.0	PLATED	2
⌀	3.2	PLATED	6
⌀	5.0	PLATED	5
⌀	7.0	PLATED	6











DIMENSION RANGE	DEFAULT TOLERANCE
0.5 ≤ 6	± 0.05
6 ≤ 30	± 0.1
30 ≤ 120	± 0.15
120 ≤ 400	± 0.2
400 ≤ 1000	± 0.3
ANGULAR	±0.05°
ALL DIMENSIONS IN MM	
DEBURR AND BREAK SHARP EDGES	

TITLE	96V PS Heat Sink		
PROJECT	Motor Control System		
DWG NO.		DRAWN	SNEHAL
MATERIAL	AL	CHK'D	MVN
SURFACE	SURFACE	APPV'D	BV
FINISH	▽▽ (▽▽▽)	DATE	04/10/20
QUANTITY	1	REVISION	1.6
PART SIZE	PART SIZE	SHEET 1 OF 1	A3
WEIGHT	WT (in Kg)	SCALE: NTS	

NO.	DATE	DESCRIPTION	APPV'D
		REVISION LIST	

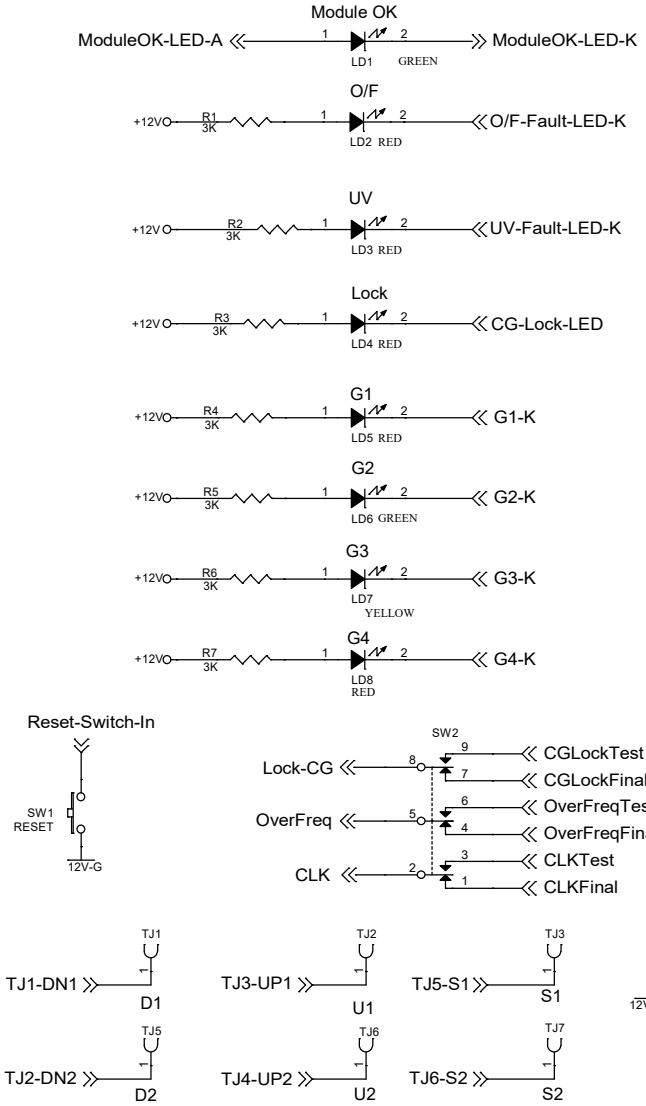
3. Control module

DRG.No.

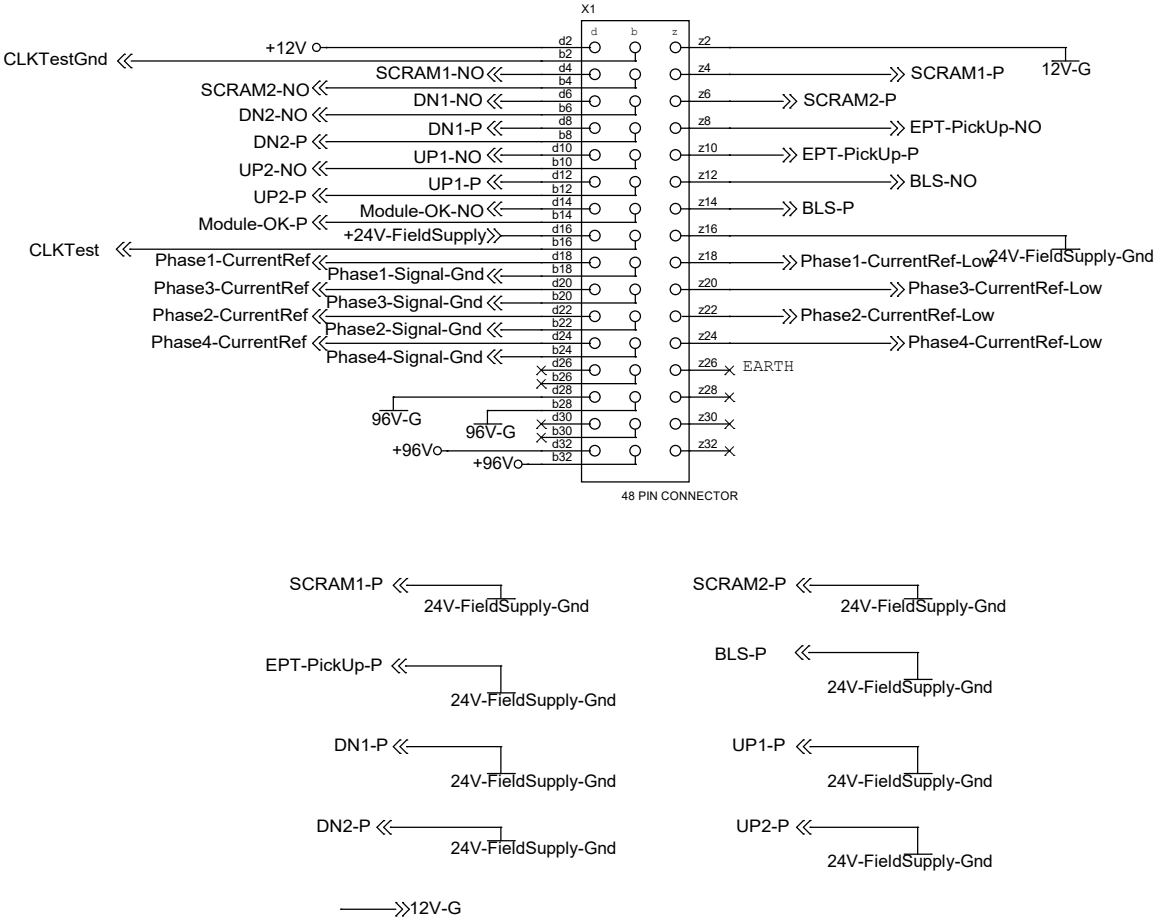
SHT. 1 OF 7

REV. 0

Front Facia

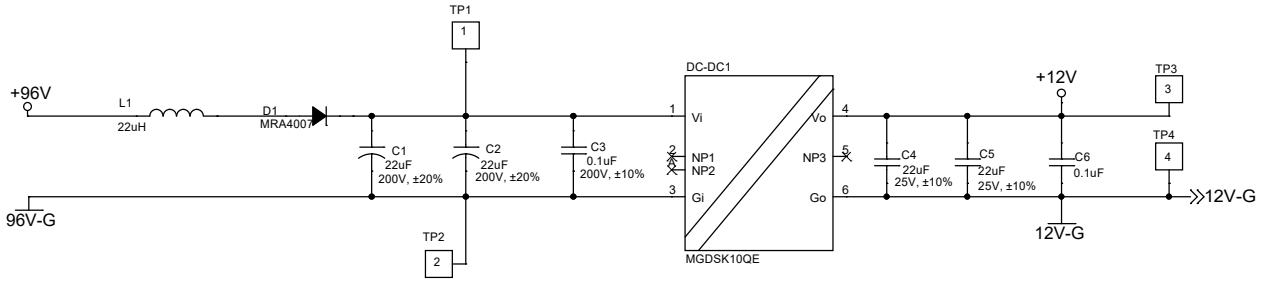


Back Facia

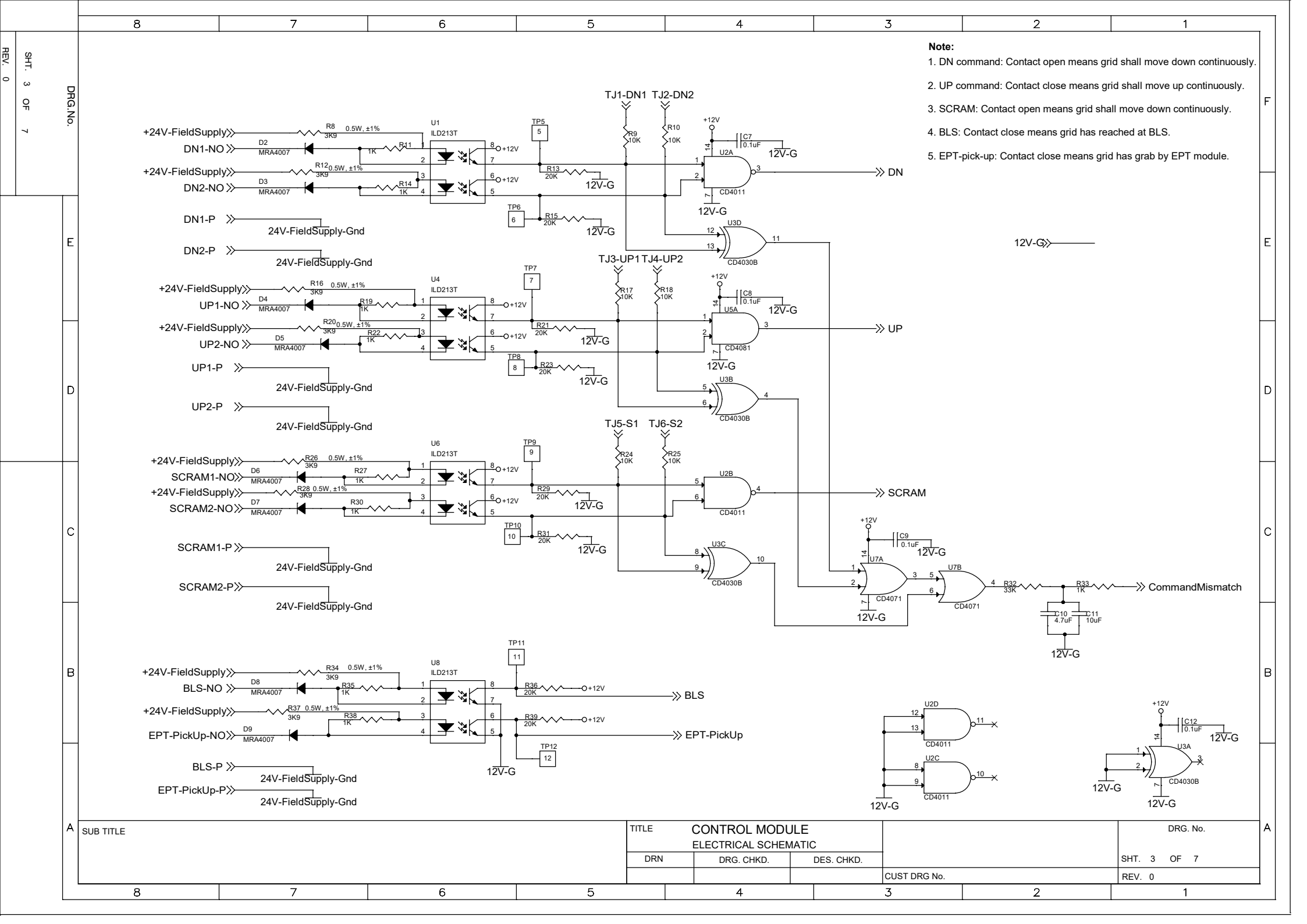


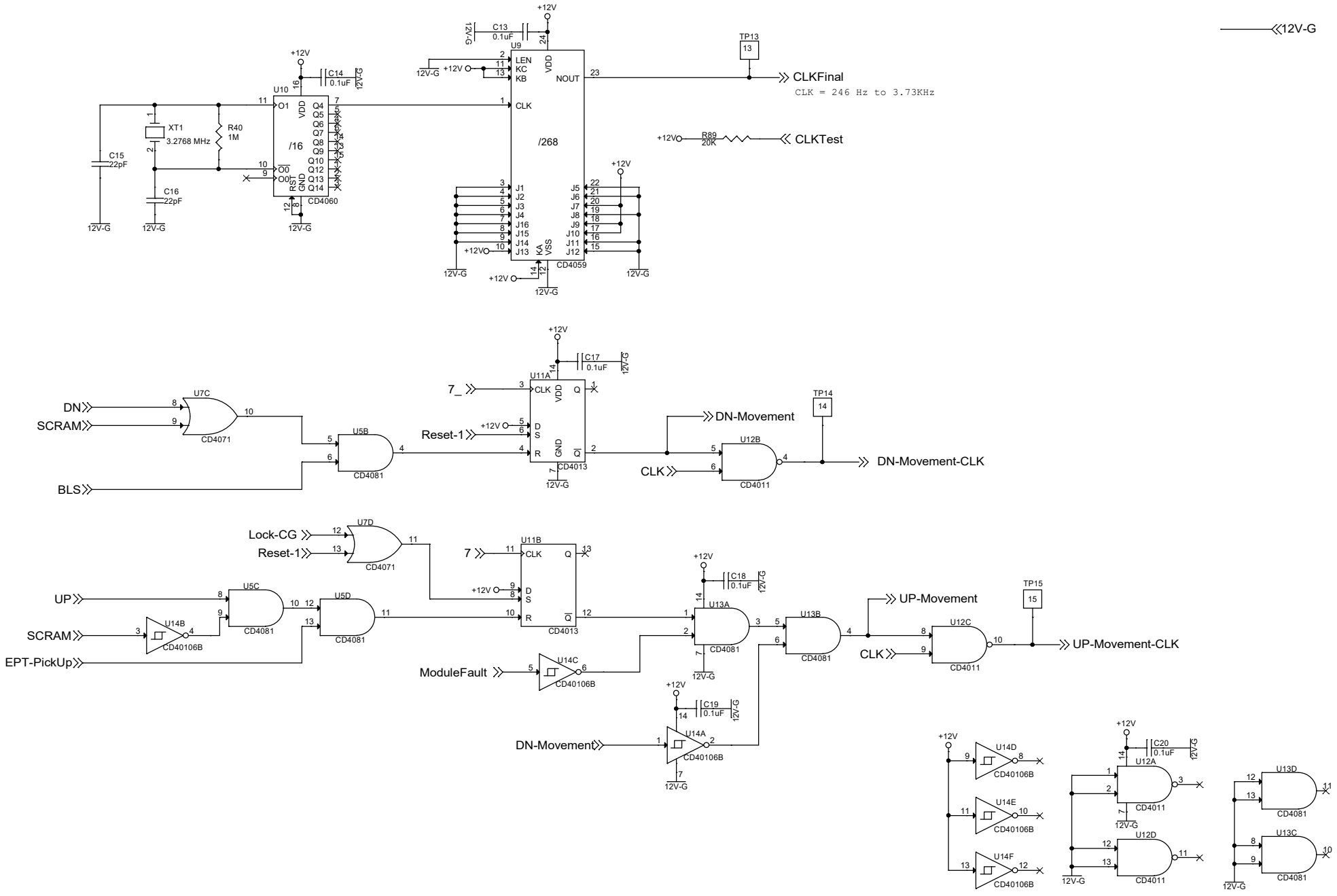
Note: All resistors are quarter watt unless specified.

					GENERAL ARRANGEMENT								TITLE	CONTROL MODULE
					BILL OF MATERIAL									ELECTRICAL SCHEMATIC
					TITLE	DRG.No.							DRN	DRG. CHKD. / DES. / DES. CHKD. / APPD.
					REFERENCE DRAWINGS									PROJ. NO.
					SCALE: PROJECTION									
No.	LOC	REVISION DESCRIPTION	DRN DATE	APPD	ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE GENERAL TOLERANCE ANGLES ± 1/2° FULL NOS. ±1 1 DEC.PLACE ±0.5 2 DEC.PLACE ±0.05 3 DEC.PLACE ±0.005		2	0	MFG					SHT. 1 OF 7
							1	0	APPROVAL					REV. 0
							ISSUE NO.	REV NO.	ISSUED FOR	PROJ.No.	ISSUE SHT.No.	DATE	APPD.	CUST DRG No.



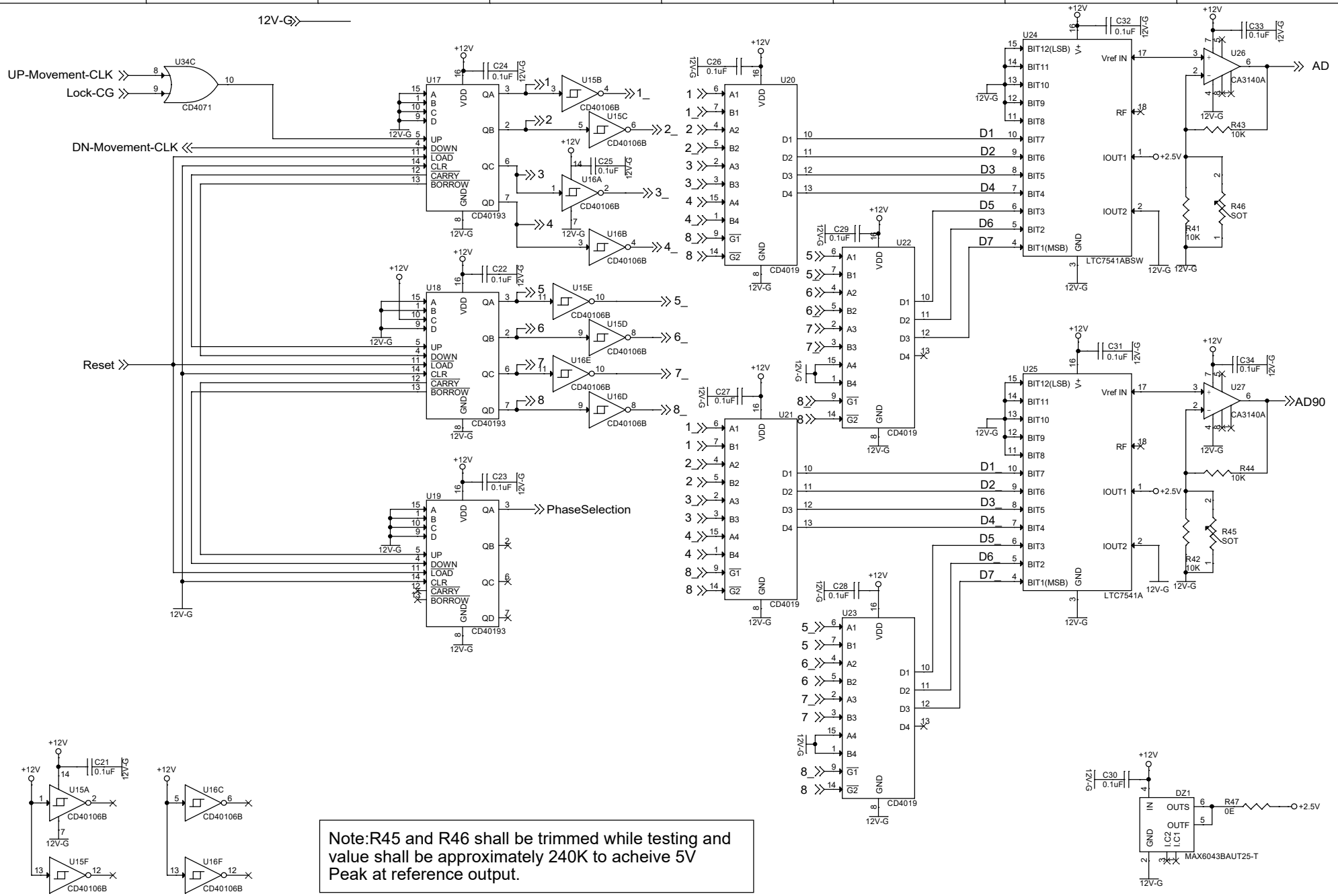
SUB TITLE	TITLE CONTROL MODULE ELECTRICAL SCHEMATIC		DRG. No.
	DRN / DRG. CHKD. / DES. CHKD.		SHT. 2 OF 7
		CUST DRG No.	REV. 0


Note:
1. DN command: Contact open means grid shall move down continuously.
2. UP command: Contact close means grid shall move up continuously.
3. SCRAM: Contact open means grid shall move down continuously.
4. BLS: Contact close means grid has reached at BLS.
5. EPT-pick-up: Contact close means grid has grab by EPT module.
TJ1-DN1 TJ2-DN2
TJ3-UP1 TJ4-UP2
TJ5-S1 TJ6-S2
+24V-FieldSupply
DN1-NO
DN2-NO
DN1-P
DN2-P
UP1-NO
UP2-NO
UP1-P
UP2-P
SCRAM1-NO
SCRAM2-NO
SCRAM1-P
SCRAM2-P
BLS-NO
EPT-PickUp-NO
BLS-P
EPT-PickUp-P
24V-FieldSupply-Gnd
ILD213T
MRA4007
CD4011
CD4030B
CD4071
CD4081
12V-G
+12V
DN
UP
SCRAM
BLS
EPT-PickUp
CommandMismatch
SUB TITLE
TITLE
CONTROL MODULE
ELECTRICAL SCHEMATIC
DRN
DRG. CHKD.
DES. CHKD.
CUST DRG No.
DRG. No.
SHT. 3 OF 7
REV. 0



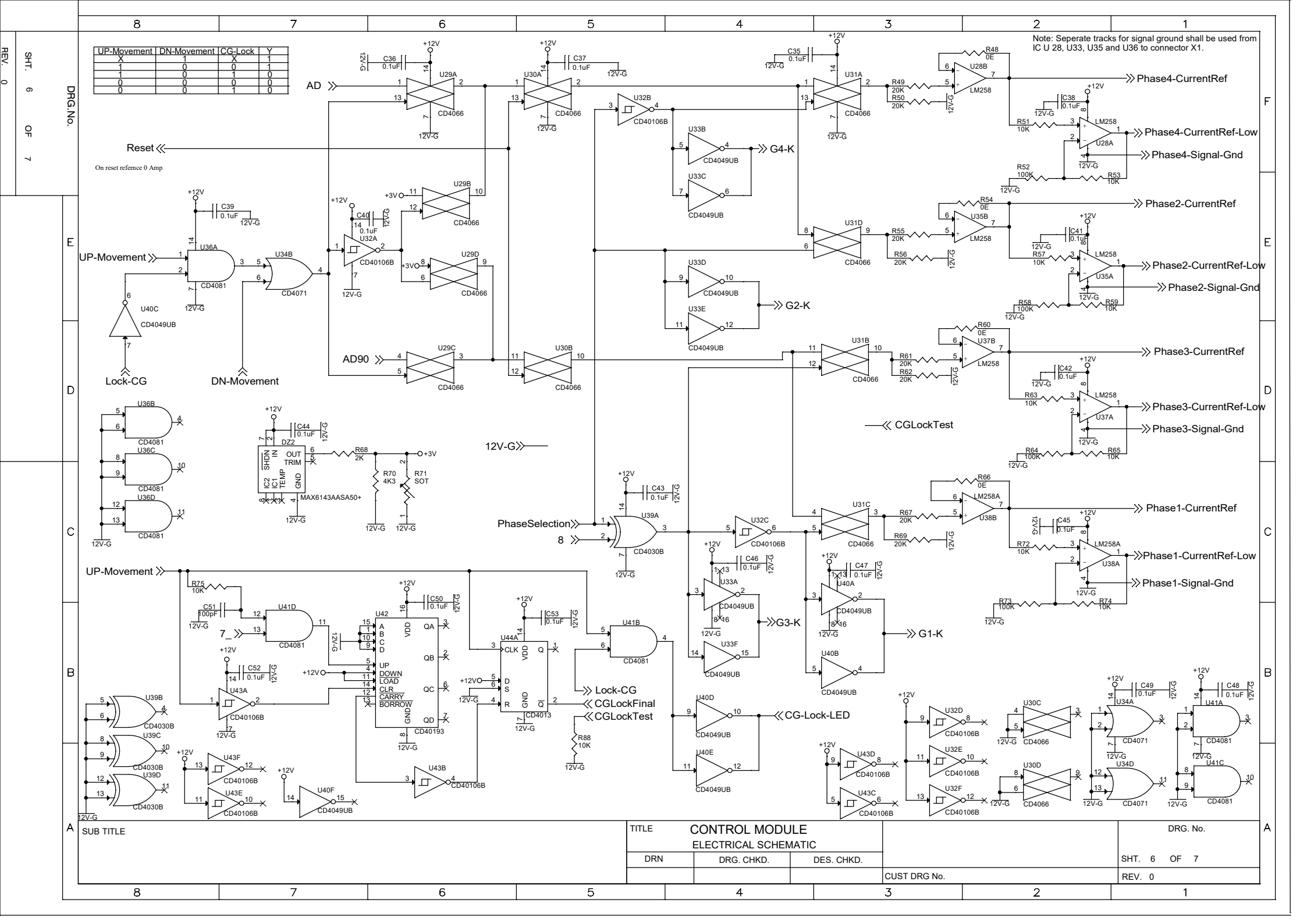
SUB TITLE	TITLE CONTROL MODULE ELECTRICAL SCHEMATIC		DRG. No.
	DRN / DRG. CHKD. / DES. CHKD.		SHT. 4 OF 7
		CUST DRG No.	REV. 0

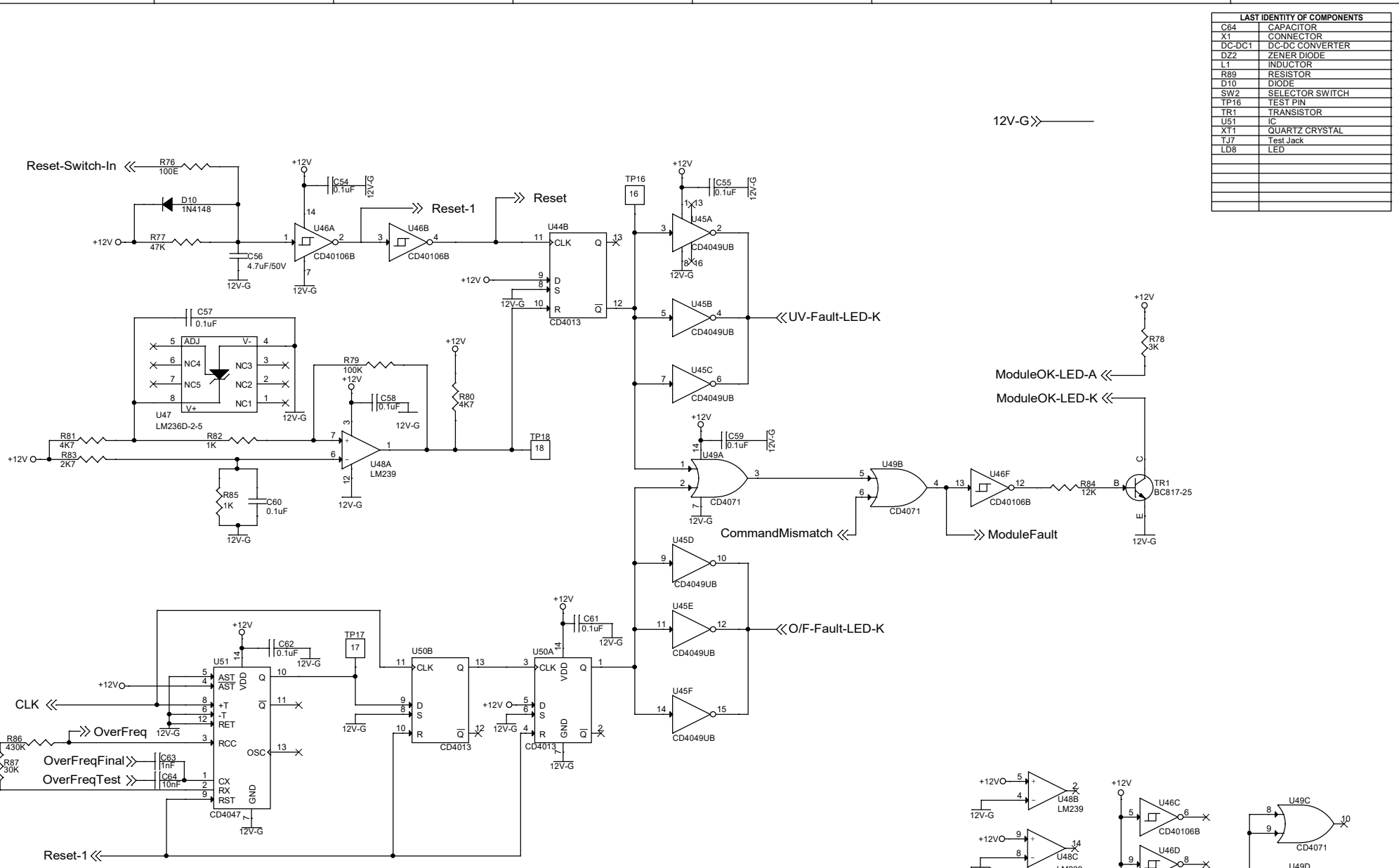
DRG.No. SHT. 4 OF 7 REV. 0



SUB TITLE	TITLE: CONTROL MODULE ELECTRICAL SCHEMATIC		DRG. No.
	DRN / DRG. CHKD. / DES. CHKD.		SHT. 5 OF 7
		CUST DRG No.	REV. 0

DRG.No. SHT. 5 OF 7 REV. 0


UP-Movement | DN-Movement | CG-Lock | Y
X | 1 | X | 1
1 | 0 | 0 | 1
1 | 0 | 1 | 0
0 | 0 | 0 | 0
0 | 0 | 1 | 0
Note: Seperate tracks for signal ground shall be used from IC U 28, U33, U35 and U36 to connector X1.
AD
Reset
On reset refernce 0 Amp
UP-Movement
Lock-CG
DN-Movement
AD90
12V-G
CGLockTest
PhaseSelection
8
7
Lock-CG
CGLockFinal
CGLockTest
Phase4-CurrentRef
Phase4-CurrentRef-Low
Phase4-Signal-Gnd
Phase2-CurrentRef
Phase2-CurrentRef-Low
Phase2-Signal-Gnd
Phase3-CurrentRef
Phase3-CurrentRef-Low
Phase3-Signal-Gnd
Phase1-CurrentRef
Phase1-CurrentRef-Low
Phase1-Signal-Gnd
G4-K
G2-K
G3-K
G1-K
CG-Lock-LED
MAX6143AASA50+
SUB TITLE
TITLE
CONTROL MODULE
ELECTRICAL SCHEMATIC
DRN
DRG. CHKD.
DES. CHKD.
CUST DRG No.
DRG. No.
SHT. 6 OF 7
REV. 0


LAST IDENTITY OF COMPONENTS
C64 CAPACITOR
X1 CONNECTOR
DC-DC1 DC-DC CONVERTER
DZ2 ZENER DIODE
L1 INDUCTOR
R89 RESISTOR
D10 DIODE
SW2 SELECTOR SWITCH
TP16 TEST PIN
TR1 TRANSISTOR
U51 IC
XT1 QUARTZ CRYSTAL
TJ7 Test Jack
LD8 LED
12V-G
Reset-Switch-In
R76 100E
D10 1N4148
R77 47K
C56 4.7uF/50V
C54 0.1uF
U46A CD40106B
U46B CD40106B
Reset-1
Reset
TP16 16
U44B CD4013
C55 0.1uF
U45A CD4049UB
U45B CD4049UB
U45C CD4049UB
UV-Fault-LED-K
C57 0.1uF
U47 LM236D-2-5
R79 100K
C58 0.1uF
R80 4K7
R81 4K7
R82 1K
R83 2K7
R85 1K
C60 0.1uF
U48A LM239
TP18 18
C59 0.1uF
U49A CD4071
U49B CD4071
U46F CD40106B
R84 12K
TR1 BC817-25
R78 3K
ModuleOK-LED-A
ModuleOK-LED-K
CommandMismatch
ModuleFault
U45D CD4049UB
U45E CD4049UB
U45F CD4049UB
O/F-Fault-LED-K
C61 0.1uF
U50A CD4013
U50B CD4013
TP17 17
C62 0.1uF
U51 CD4047
CLK
OverFreq
OverFreqFinal
OverFreqTest
R86 430K
R87 30K
C63 1nF
C64 10nF
Reset-1
U48B LM239
U48C LM239
U48D LM239
U46C CD40106B
U46D CD40106B
U46E CD40106B
U49C CD4071
U49D CD4071
SUB TITLE
TITLE
CONTROL MODULE
ELECTRICAL SCHEMATIC
DRN
DRG. CHKD.
DES. CHKD.
CUST DRG No.
DRG. No.
SHT. 7 OF 7
REV. 0
DRG.No.
SHT. 7 OF 7
REV. 0

REV. NO.	DATE	REVISIONS / ISSUES	PREPARED	APPROVED
0		ISSUED FOR APPROVAL		

REFERENCE
CL

DATE
PREPD
CHKD
APPD

CONTROL MODULE
BILL OF MATERIAL

PROJ. NO.

BM-

SHT. 1 OF 5

REV. 0

BM-

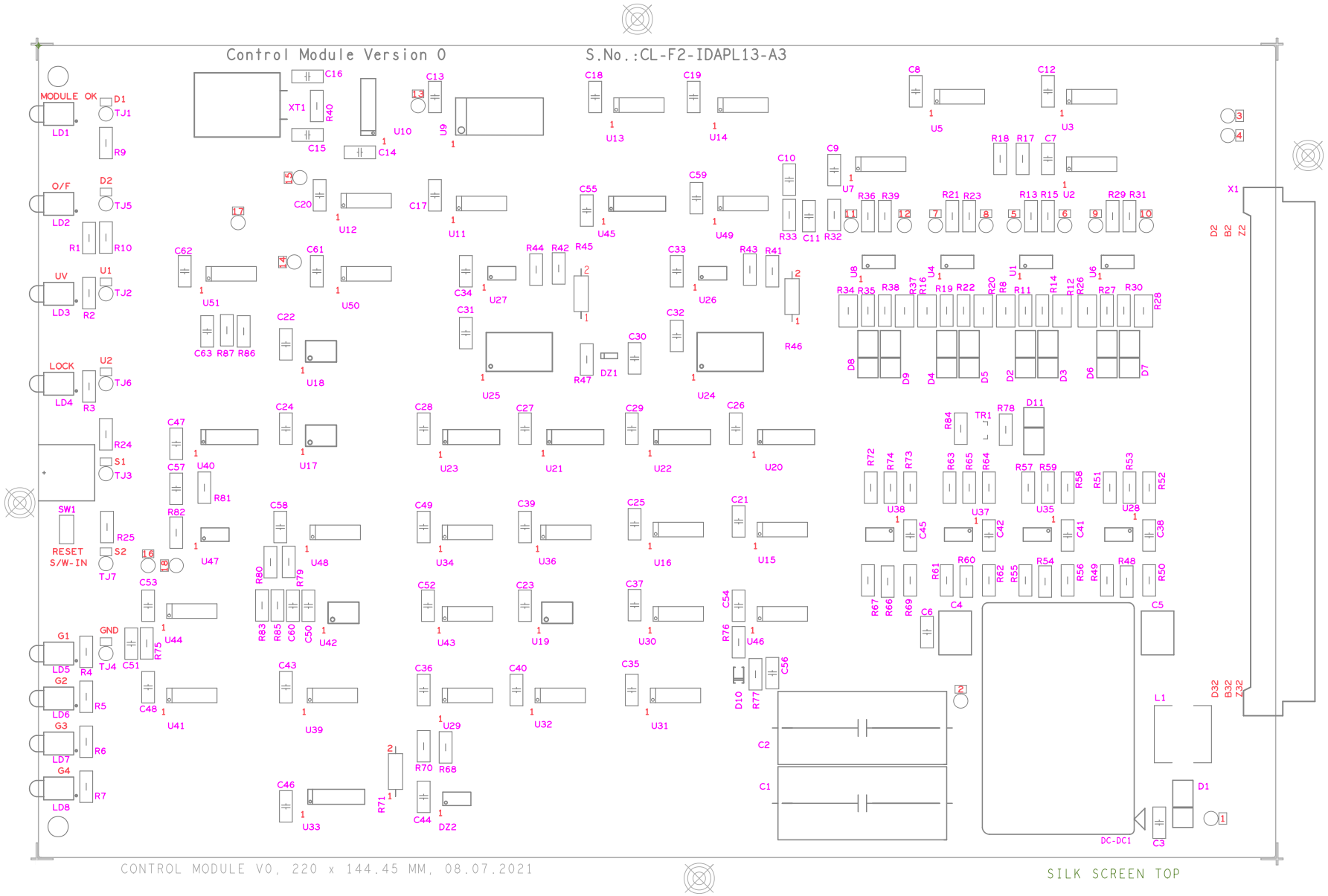
ITEM NO.	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./ DRG. NO./ MAKE&TYPE	REMARKS	PROC REF.
1	PRINTED CIRCUIT	PCB1	1			
2	Electolytic capacitor	C1,C2	2	Vishay	through hole,size:12.5 x	
	22µF/200V , 20%, 12.5 x			MAL211892229E3		
3	Capacitor	C3	1	KEMET	SMD 1206 package	
	0.1µF/200V, 10%,			C1206C104K2RACTU		
4	Capacitor	C4,C5	2	KEMET	SMD 2220 package	
	22µF/25V,10%, smd:2220			C2220C226K3RACTU		
5	Capacitor	C6,C7,C8,C9,C12,C13,C14,C17,C18, C19, C20,C21,C22,C23,C24,C25,C26,C27, C28, C29,C30,C31,C32,C33,C34,C35,C36, C37,	51	Vishay	SMD 1206 package	
	0.1µF/50V , 10%,			VJ1206Y104KXAAT		
6	Capacitor	C10	1	KEMET	SMD 1206 package	
	4.7µF/25V, 10%,smd:1206			C1206C475K3RACTU		
7	Capacitor	C11	1	KEMET	SMD 1206 package	
	10µF/25V, 10%, smd:1206			C1206C106K3RACTU		
8	Capacitor	C15,C16	2	KEMET	SMD 1206 package	
	22pF 50V, ±5% ,SMD			C1206C220J5GAC		
9	Capacitor	C51	1	KEMET	SMD 1206 package	
	100pF/50V,10%,			C1206C101K5GACTU		
10	Capacitor	C56	1	KEMET	SMD 1206 package	
	4.7µF/50V,10%, smd:1206			C1206C475K5RACTU		
11	Capacitor	C63	1	KEMET	SMD 1206 package	
	1nF/50V , 5% , SMD :			C1206C102J5GACTU		
12	Capacitor	C64	1	KEMET	SMD 1206 package	
	10nF/50V , 5% , SMD :			C1206C103J5GACTU		
13	DC-DC Converter	DC-DC1	1	GAIA		
	i/p 36-140V, O/p 12V,			MGDSK10QE	Metal case, Single	
14	VOLTAGE REFERENCE	DZ1	1	Maxim	6 pin surface	
	2.5V ± 0.5%,727mW			MAX6043BAUT25-T	mount SOT23 package	
15	VOLTAGE REFERENCE	DZ2	1	Maxim Integrated	8 pin SO Package	
	5V SOIC-8			MAX6143AASA50+		
16	Diode	D1,D2,D3,D4,D5,D6,D7,D8,D9	9	On Semi		
	SMD: DO-214AC package			MRA4007T3G		
17	Diode	D10	1	Vishay Semiconductors		
	SMD/SMT SOD-123			1N4148W-HE3-08		
18	Light Emiting Diode	LD1,LD2,LD3,LD4,LD5,LD6,LD7,LD8	8	Local vendor	LD1,LD6 - Green	
	Dia-3mm, pitch-2.5mm				LD2,LD3,LD4,LD5,LD8-	
					LD7 - Yellow	
19	Differential Mode Choke	L1	1	VISHAY		
	22uH , 5A			IHLP4040DZER220M11		
20	Relay	RL1	1	Not Used		
	12V DC					
	DRN CHKD	CUST. REF.			**BM-**	
					SHT. 2 OF 5	
					REV. 0	

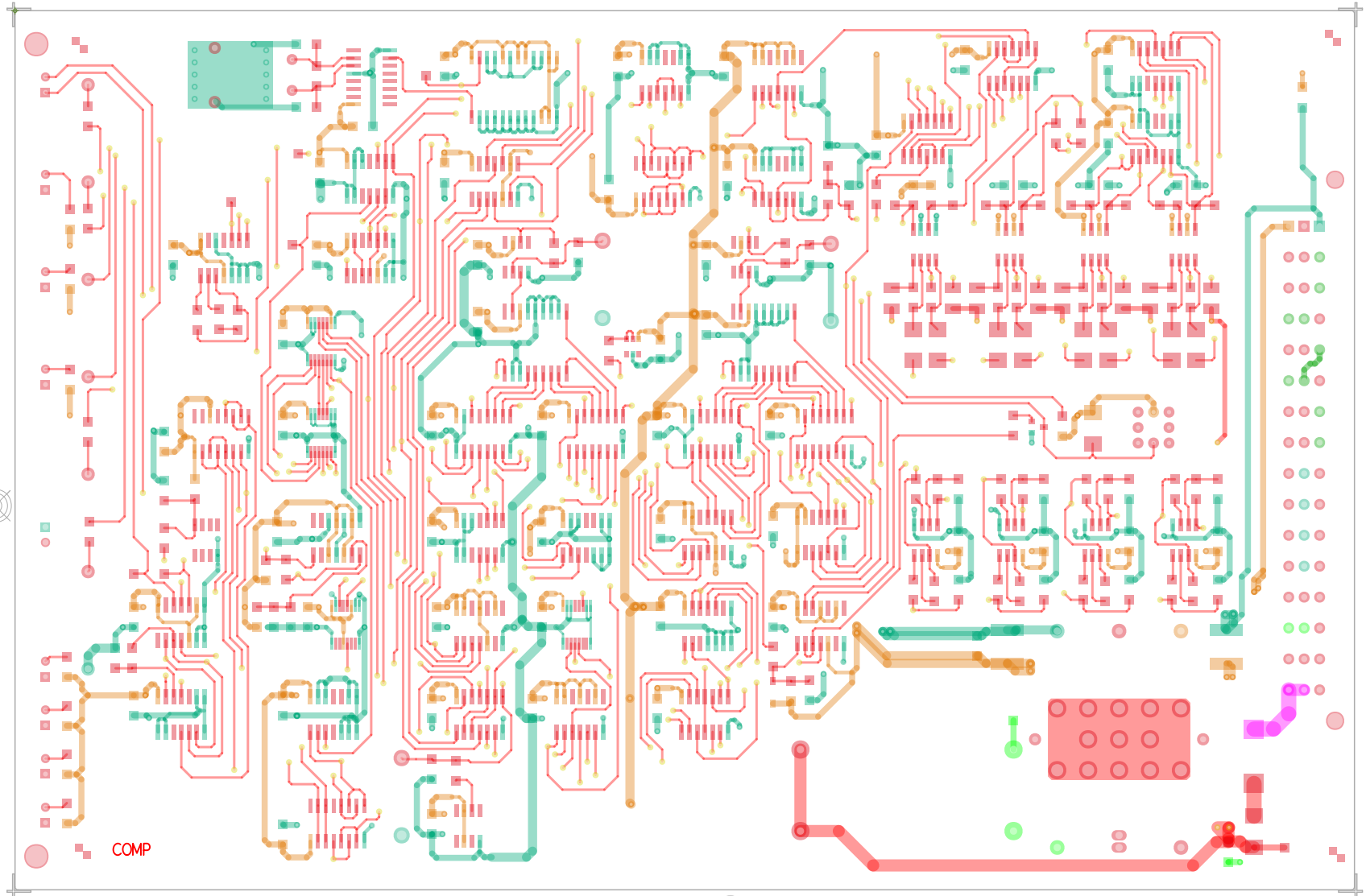
ITEM	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./	REMARKS	PROC.
NO.				DRG. NO./		REF.
21	Resistor	R1,R2,R3,R4,R5,R6,R7,R78	8	ROHM Semiconductor		
	3K 0.25W, ±1%			KTR18EZPF3001 SMD :		
22	10K 0.25W, ±1%			KTR18EZPF1002 SMD :		
23	Resistor	R8,R12,R16,R20,R26,R28,	8	Yageo		
	3K9 0.5W, ±1%	R34,R3		RC1210FR-073K9L SMD :		
24	Resistor	R11,R14,R19,R22,R27,R30,	11	ROHM Semiconductor		
	1K 0.25W, ±1%	R33,R35,R38,R82,R85		KTR18EZPF1001 SMD :		
25	Resistor	R13,R15,R21,R23,R29,R31,	17	ROHM Semiconductor		
	20K 0.25W, ±1%	R36,R39,R49, R50, R55,		KTR18EZPF2002 SMD :		
		R56, R61,R62,R67,R69, R89				
26	Resistor	R32	1	ROHM Semiconductor		
	33K 0.25W, ±1%			KTR18EZPF3302 SMD :		
27	Resistor	R40	1	Vishay		
	1M 0.25W, ±1%			CRCW12061M00FKEAC		
				SMD : 1206		
28	SOT	R45,R46,R71	3	CHANDSONS , through hole		
29	Resistor	R47,R48,R54,R60,R66	5	Yageo		
	0E 0.25W, ±1%			AF1206JR-070RL Smd:1206		
30	Resistor	R52,R58,R64,R73,R79	5	ROHM Semiconductor		
	100K 0.25W, ±1%			KTR18EZPF1003 SMD :		
31	Resistor	R68	1	ROHM		
	2K 0.25W, ±1%			KTR18EZPF2001 SMD :		
32	Resistor	R70	1	ROHM Semiconductor		
	4K3 0.25W, ±1%			KTR18EZPF4301 SMD :		
33	Resistor	R76	1	ROHM Semiconductor		
	100E 0.25W, ±1%			KTR18EZPF1000 SMD :		
34	Resistor	R77	1	ROHM Semiconductor		
	47K 0.25W, ±1%			KTR18EZPF4702 SMD 1206		
35	Resistor	R80,R81	2	ROHM Semiconductor		
	4K7 0.25W, ±1%			KTR18EZPF4701 SMD :		
36	Resistor	R83	1	ROHM Semiconductor		
	2K7 0.25W, ±1%			KTR18EZPF2701 SMD :		
37	Resistor	R84	1	VISHAY		
	12K 0.25W, ±5%			CRCW120612K0JNEA		
	DRN CHKD	CUST. REF.			BM-	
					SHT. 3 of 5	
					REV. 0	

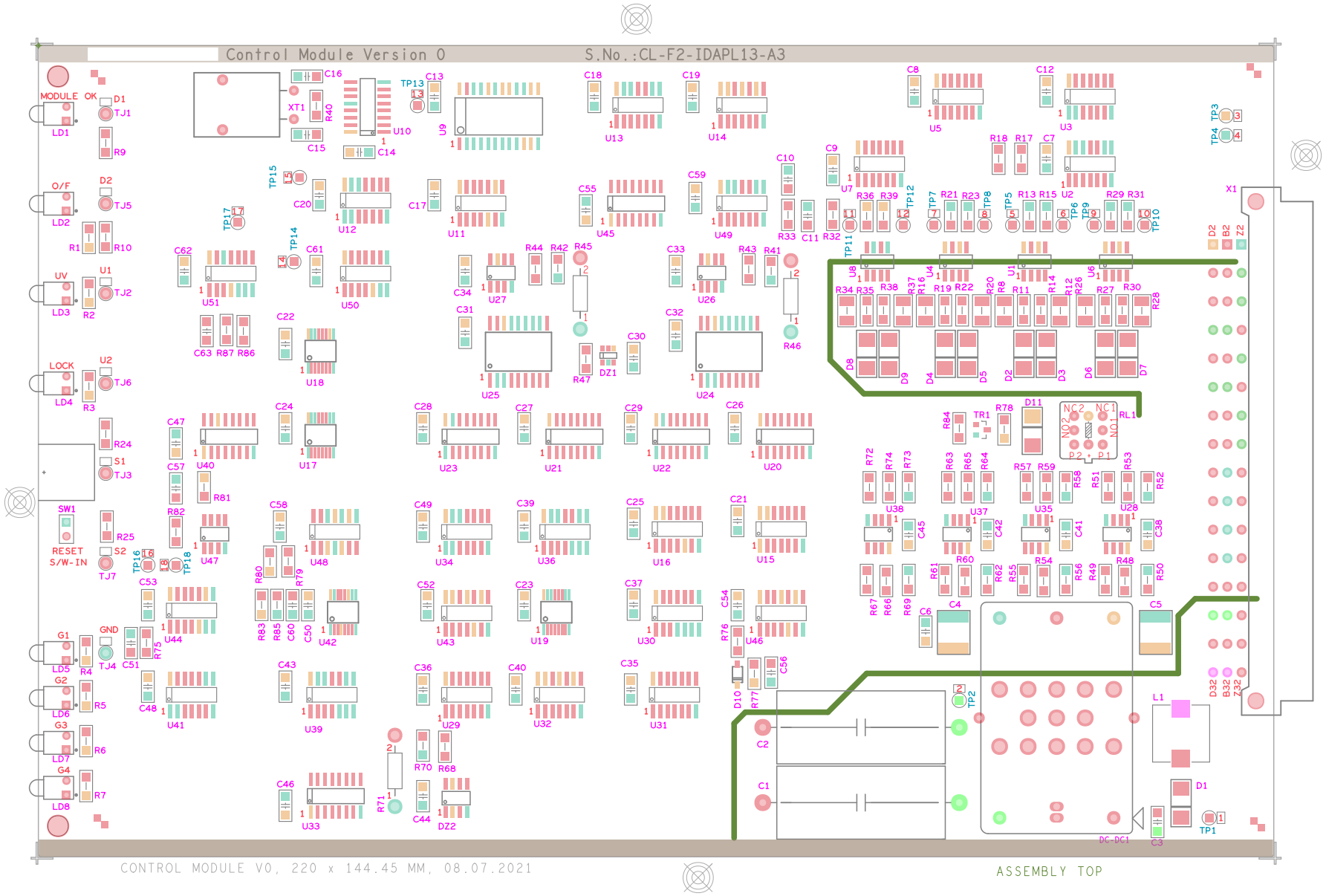
ITEM	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./	REMARKS	PROC.
38	Resistor	R86	1	ROHM Semiconductor		
	430K 0.25W, ±1%			KTR18EZPF4303 SMD:		
39	Resistor	R87	1	ROHM Semiconductor		
	30K 0.25W, ±1%			KTR18EZPF3002 SMD:		
40	MINIATURE PUSH	SW1	1	KNITTER-SWITCH	Front	
				MPE 206R		
41	Toggle Switch	SW2	1	KNITTER-SWITCH	Front	
	3PDT, 6A,125V			M2032SS1W01		
42	Testpoint	TJ1,TJ2,TJ3,TJ4,TJ5,TJ6	7	mittal electronics (ME-47)	Front	
43	Test Point	TP1 - TP16	16	2mm X 2 mm copper on		
44	NPN Transistor	TR1	1	Diodes Incorporated		
	BC817-25 , 45V			BC817-25 SMD : SOT23		
45	Optocoupler	U1,U4,U6,U8	4	VISHAY		
	ILD213T			ILD213T , SOIC 8		
	8 PIN IC					
46	CMOS Quad 2-Input	U2 , U12	2	TEXAS INSTRUMENTS	SOIC-14N	narrow
	CD4011B , 14 PIN IC			CD4011BM , SOIC - 14		package
47	CMOS Quad	U3, U39	2	TEXAS INSTRUMENTS	SOIC-14N	narrow
	CD4030B , 14 pin IC			CD4030BM , SOIC - 14		package
48	CMOS Quad 2-Input	U5,U13,U36,U41	4	TEXAS INSTRUMENTS	SOIC-14N ,	narrow
	CD4081, 14 pin IC			CD4081BM , SOIC - 14		package
49	CMOS Quad 2-Input	U7,U34,U49	3	TEXAS INSTRUMENTS	SOIC-14N ,	narrow
	CD4071 , 14 pin IC			CD4071BM, SOIC 14		package
50	CMOS	U9	1	TEXAS INSTRUMENTS	DW	package
	CD4059A , 24 PIN IC			CD4059AM , soic-24		
51	CMOS 14-Stage	U10	1	TEXAS INSTRUMENTS	SOIC-16N ,	narrow
	CD4060B , 16 PIN IC			CD4060BM , SOIC-16	refer	package
52	Dual D Flip Flop	U11,U44,U50	3	TEXAS INSTRUMENTS	SOIC-14N	narrow
	CD4013 , 14 PIN IC			CD4013BM , SOIC 14		package
53	CMOS Hex Schmitt	U14,U15,U16,U32,U43,U	6	TEXAS INSTRUMENTS	SOIC-14N	narrow
	CD40106B , 14 pin IC			CD40106BM, SOIC 14		package
54	Converters	U24,U25	2	Analog Devices	SO-18 ,	SOIC-18W
	LTC7541A , 18 PIN			LTC7541ABSW		
	DRN CHKD	CUST. REF.			BM-	
					SHT. 4 of 5	
					REV. 0	

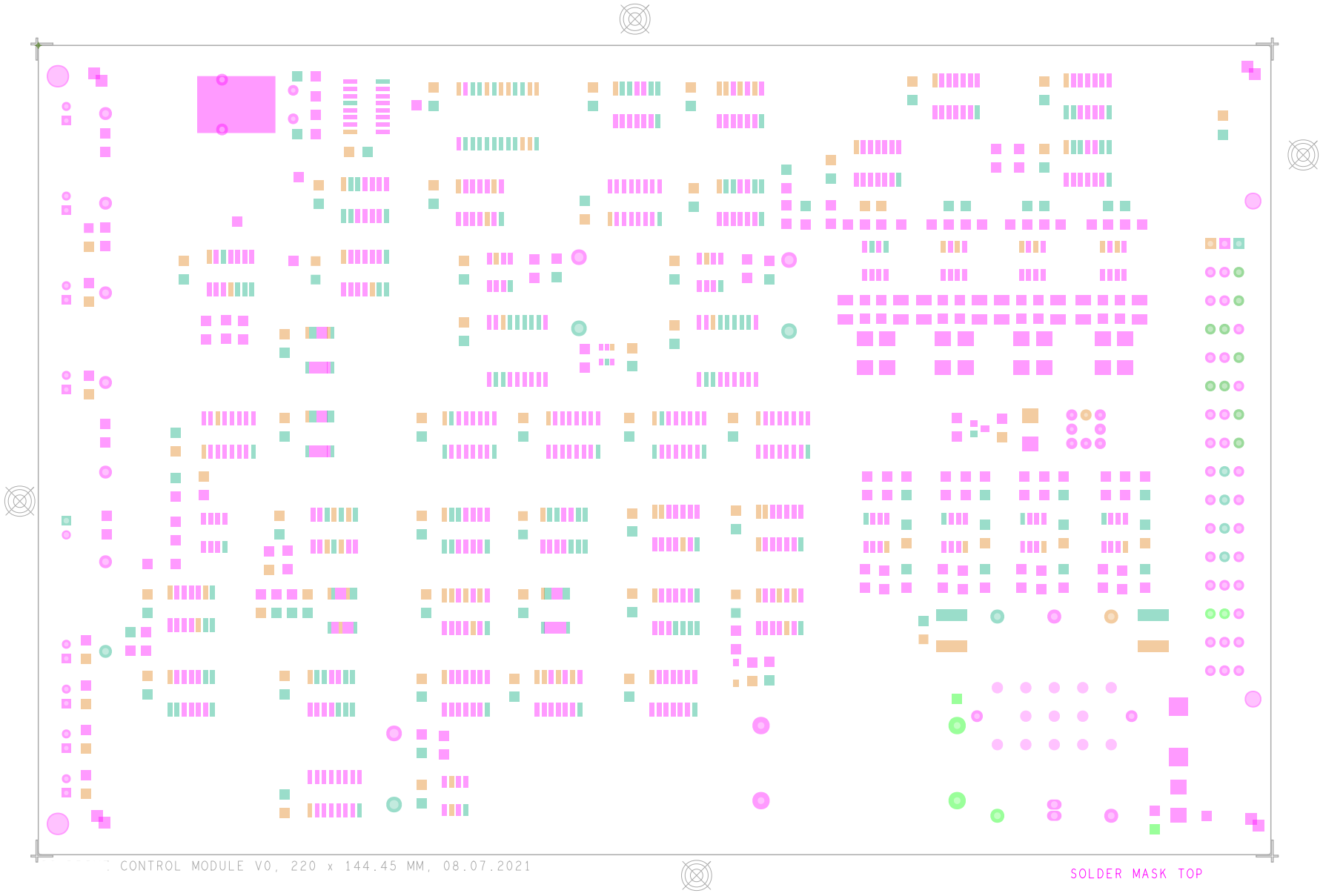
ITEM	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./	REMARKS	PROC.
55	BiMOS operational	U26,U27	**2**	Renesas Electronics	SOIC-8	SOIC-8P
	CA3140A , 8 pin ic			CA3140AMZ		
56	Presettable Bin	U17,U18,U19,U42	**4**	TEXAS INSTRUMENTS	TSSOP-16	wide package
	CD40193 , 16 pin IC			CD40193BPW		
57	Quad AND/OR Select	U20,U21,U22,U23	**4**	TEXAS INSTRUMENTS	SOIC-16N ,	narrow package
	CD4019b , 16 pin IC			CD4019BM ,SOIC-16		
58	Dual Operational	U28,U35,U37,U38	**4**	TEXAS INSTRUMENTS	SOIC-8 , D	SOIC-8P
	LM258 , 8 PIN IC			LM258DR , SOIC-8		narrow package
59	Switch	U29,U30,U31	**3**	TEXAS INSTRUMENTS	SOIC-14N ,	narrow package
	CD4066b , 14 PIN IC			CD4066BM , SOIC-14		
60	CMOS Hex Inverting	U33,U40,U45	**3**	TEXAS INSTRUMENTS	SOIC-16N,	narrow package
	CD4049UB , 16 PIN			CD4049UBD , SOIC-16		
61	Integrated Reference	U47	**1**	TEXAS INSTRUMENTS	SOIC-8 , D	SOIC-8P
	LM236 , 8 PIN IC			LM236D-2.5V , SOIC - 8	narrow	
	ILD213T			ILD213T , SOIC 8		
	8 PIN IC					
62	QUAD	U48	1	TEXAS INSTRUMENTS	SOIC-14N	narrow package
	LM239			LM239		
	14 PIN IC			SOIC 14		
63	Monostable Multi-	U51	1	TEXAS INSTRUMENTS	SOIC-14N ,	narrow package
	CD4047b , 14 pin IC			CD4047BM , SOIC-14		
64	QUARTZ CRYSTAL	XT1	1	Andhra		
	3.2768 MHz			49U2FIK122P003M27680		
65	Connector	X1	**1**	09061487901	DIN 41 612	
	48 PIN MALE			HARTING		

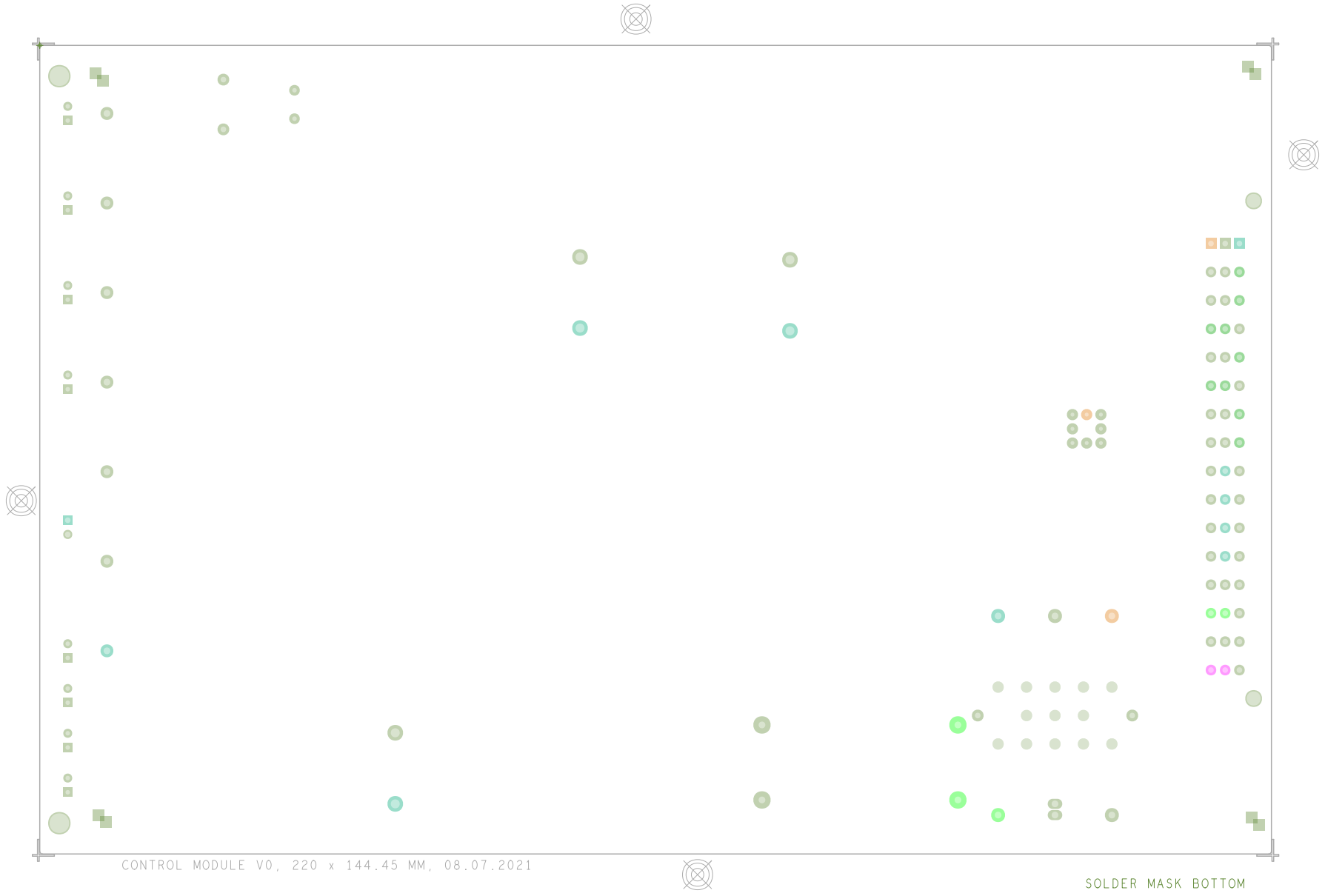
	DRN	CHKD	CUST. REF.			BM-	
						SHT. 5 of 5	
						REV. 0	

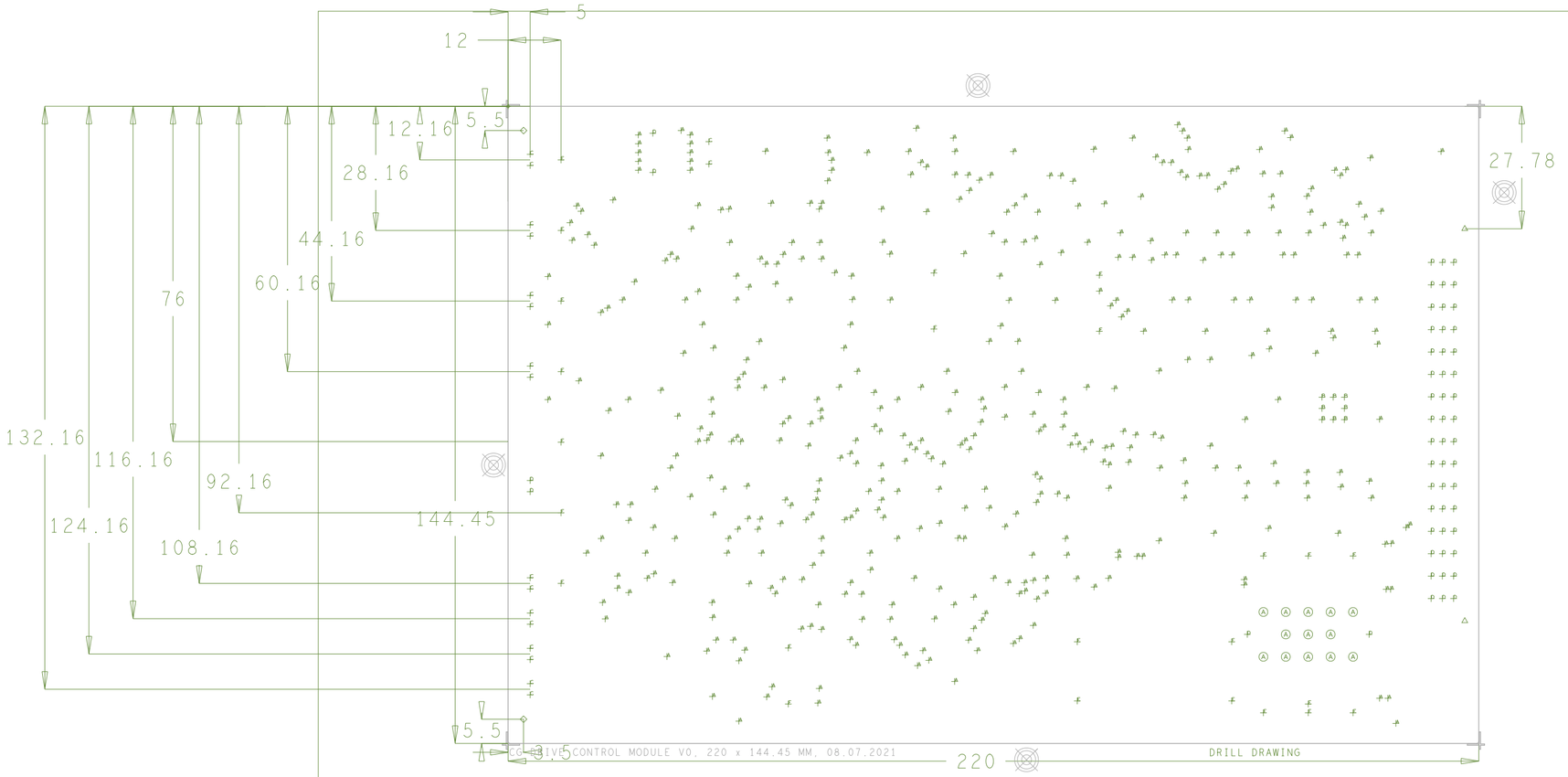

Control Module Version 0
S.No.:CL-F2-IDAPL13-A3
MODULE OK
O/F
UV
LOCK
RESET
S/W-IN
G1
G2
G3
G4
GND
DC-DC1
CONTROL MODULE V0, 220 x 144.45 MM, 08.07.2021
SILK SCREEN TOP


COMP
CONTROL MODULE V0, 220 x 144.45 MM, 08.07.2021
L1-TOP


Control Module Version 0
S.No.:CL-F2-IDAPL13-A3
CONTROL MODULE V0, 220 x 144.45 MM, 08.07.2021
ASSEMBLY TOP


CONTROL MODULE V0, 220 x 144.45 MM, 08.07.2021
SOLDER MASK TOP


CONTROL MODULE V0, 220 x 144.45 MM, 08.07.2021
SOLDER MASK BOTTOM



PCB FAB DETAILS:

1. 2 LAYER PCB
2. PCB MATERIAL : FR4 GLASS EPOXY
3. PCB THICKNESS 1.6 MM
4. COPPER THICKNES 70 MICRONS
5. TINNING ENIG
6. MASKING GREEN
7. ALL DIMENSIONS ARE IN MM

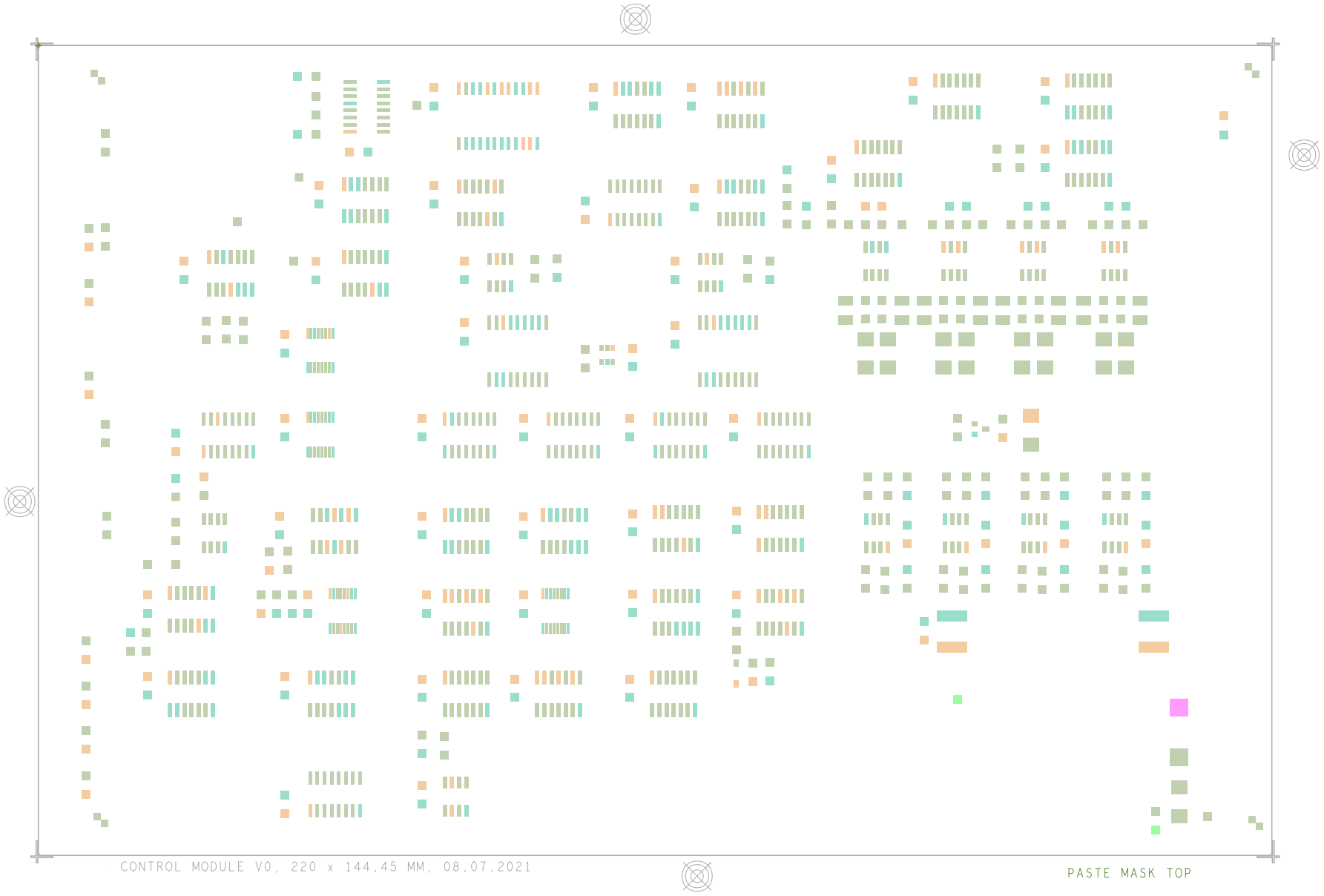
DFM ANALYSIS(MM)		
MIN AIRGAP	PAD/PAD	0.3
	PAD/TRACE	0.3
	TRACE/TRACE	0.3
MIN. TRACE WIDTH		0.4
MIN. F.H.S FOR PTH		0.5
IMPEDANCE		NO

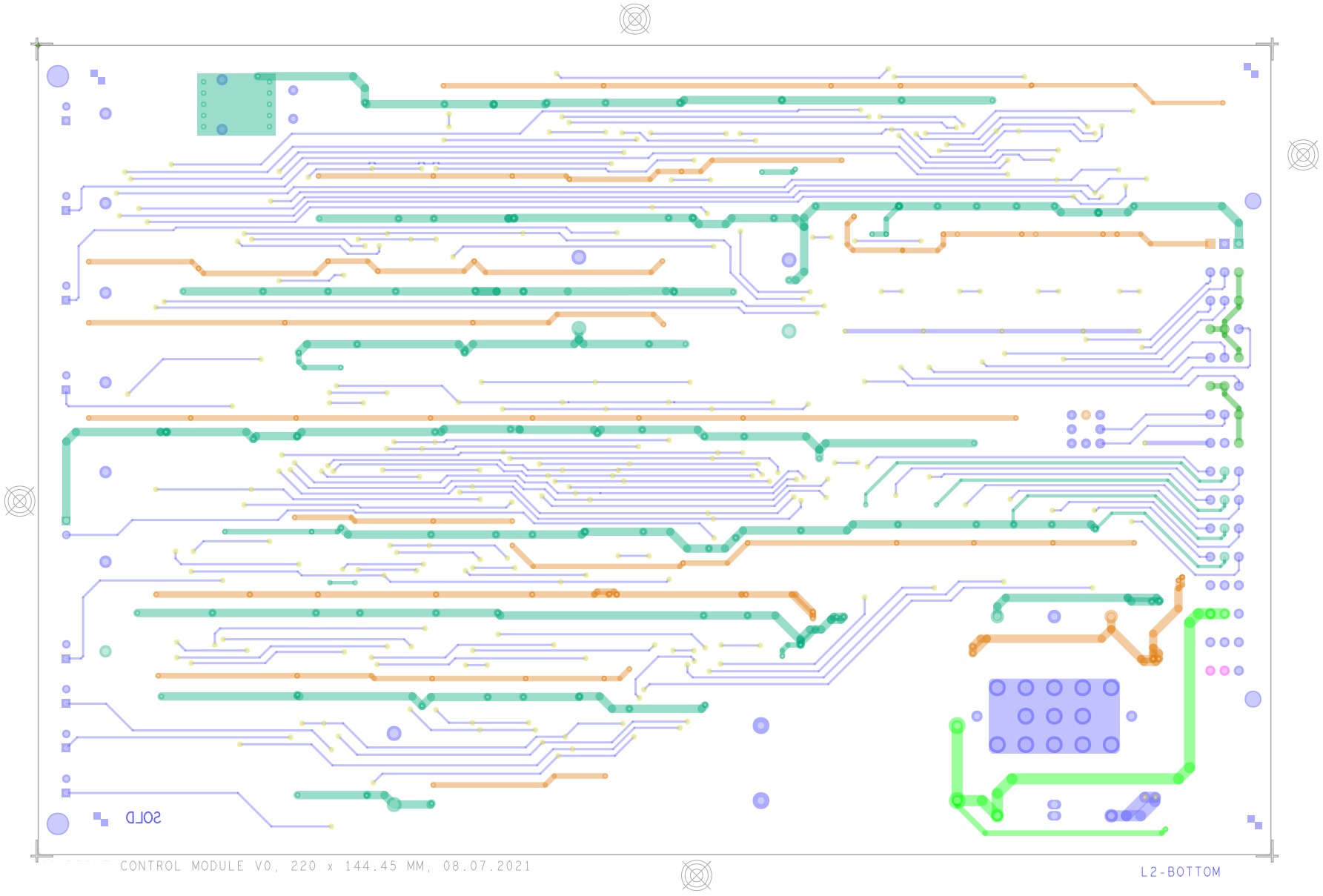
DRILL CHART: TOP to BOTTOM

ALL UNITS ARE IN MILLIMETERS

FIGURE	FINISHED_SIZE	PLATED	QTY
+	0.5	PLATED	460
+	0.7	PLATED	8
+	0.8	PLATED	18
+	1.0	PLATED	54
+	1.2	PLATED	18
+	1.6	PLATED	6
Ⓐ	2.0	PLATED	13
△	2.5	PLATED	2
◇	3.5	PLATED	2

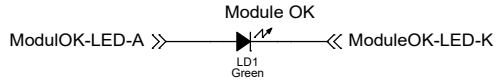
TITLE:	CONTROL MODULE	REV. 0
DESCRIPTION:		

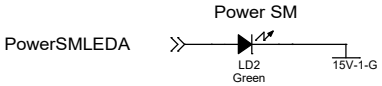

CONTROL MODULE V0, 220 x 144.45 MM, 08.07.2021
PASTE MASK TOP

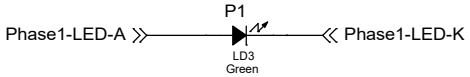

SOLD
CONTROL MODULE V0, 220 x 144.45 MM, 08.07.2021
L2-BOTTOM

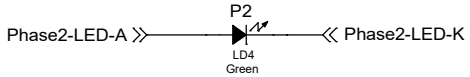
4. Power module

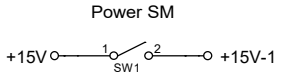
Front Facia

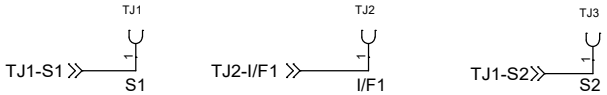


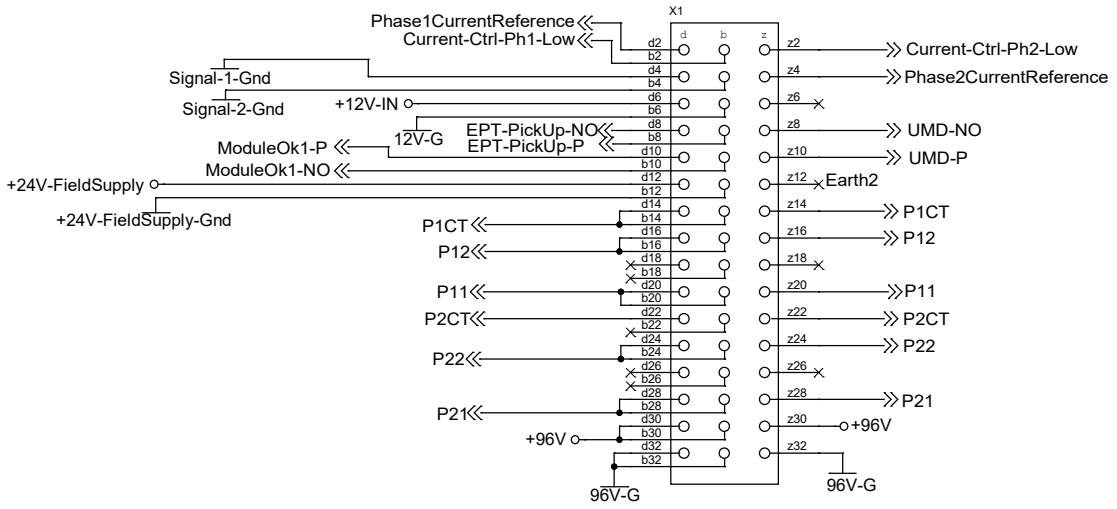


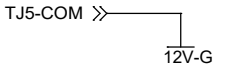


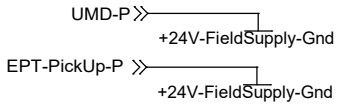


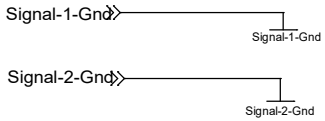












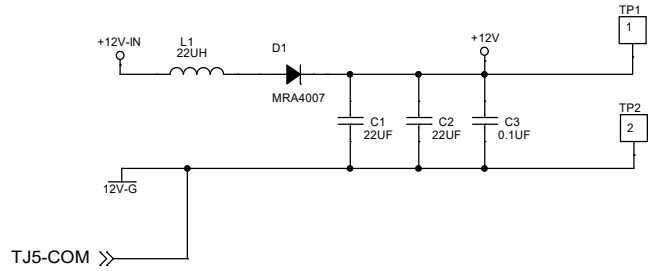
					GENERAL ARRANGEMENT								
					BILL OF MATERIAL								
					TITLE	DRG.No.							
					REFERENCE DRAWINGS								
					SCALE: PROJECTION								
No.	LOC	REVISION DESCRIPTION	DRN DATE	APPD	ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE GENERAL TOLERANCE ANGLES ± 1/2° FULL NOS. ±1 1 DEC.PLACE ±0.5 2 DEC.PLACE ±0.05 3 DEC.PLACE ±0.005		ISSUE NO.	REV NO.	MFG APPROVAL ISSUED FOR	PROJ.No.	ISSUE SHT.No.	DATE	APPD.

TITLE: POWER MODULE
ELECTRICAL SCHEMATIC

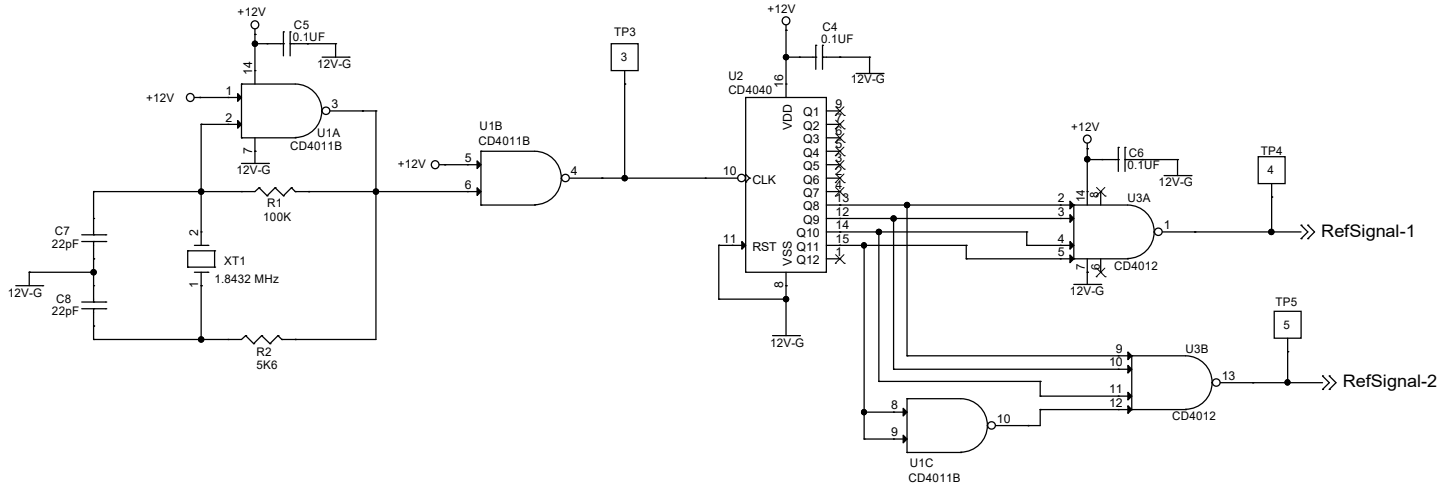
DRN	DRG. CHKD.	DES.	DES. CHKD.	APPD.
				PROJ. NO.

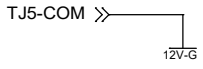
CUST DRG No.

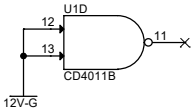
SHT. 1 OF 11
REV. 0



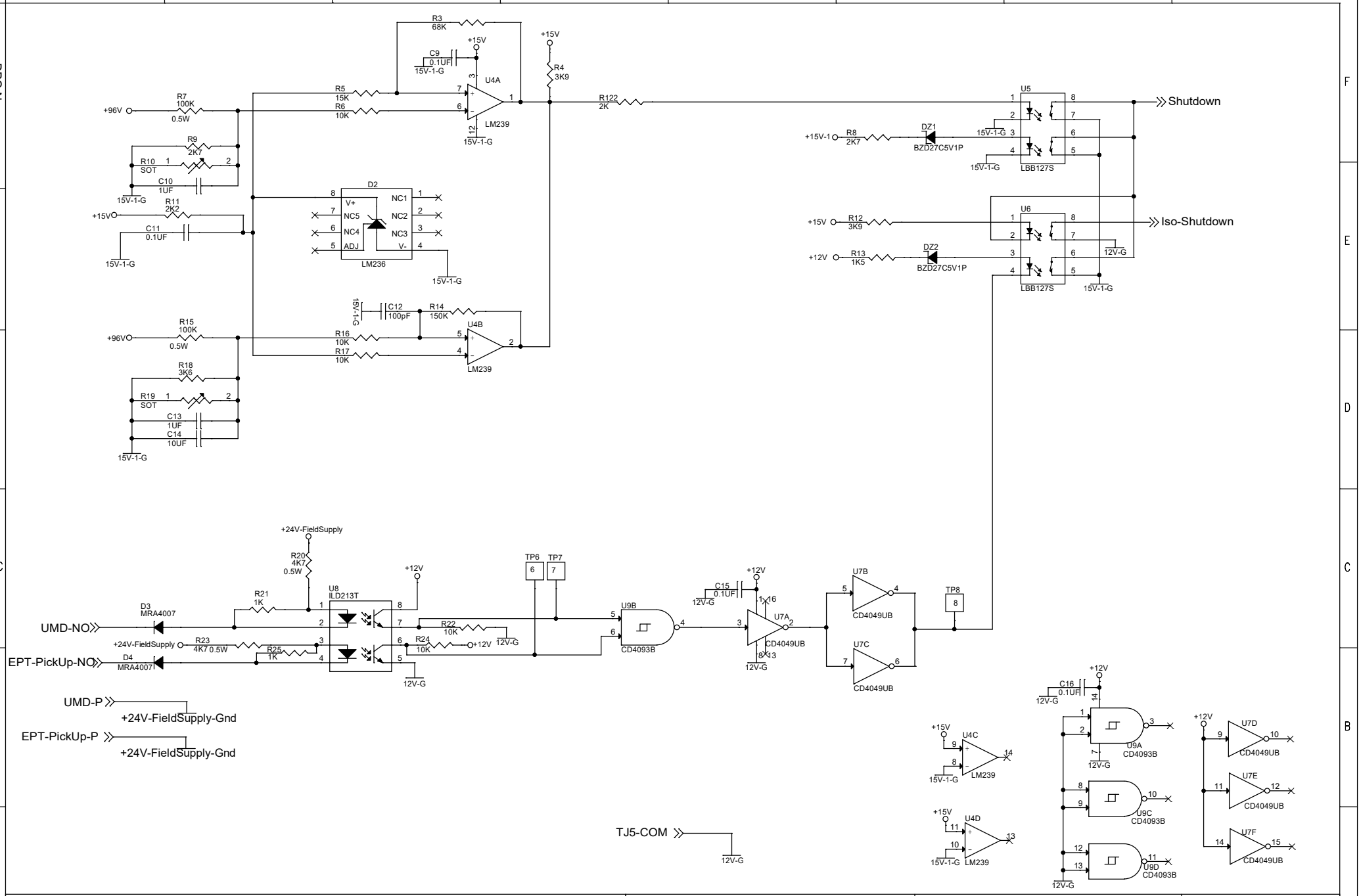
SUB TITLE	TITLE POWER MODULE ELECTRICAL SCHEMATIC		DRG. No.
	DRN / DRG. CHKD. / DES. CHKD.		SHT. 2 OF 11
		CUST DRG No.	REV. 0







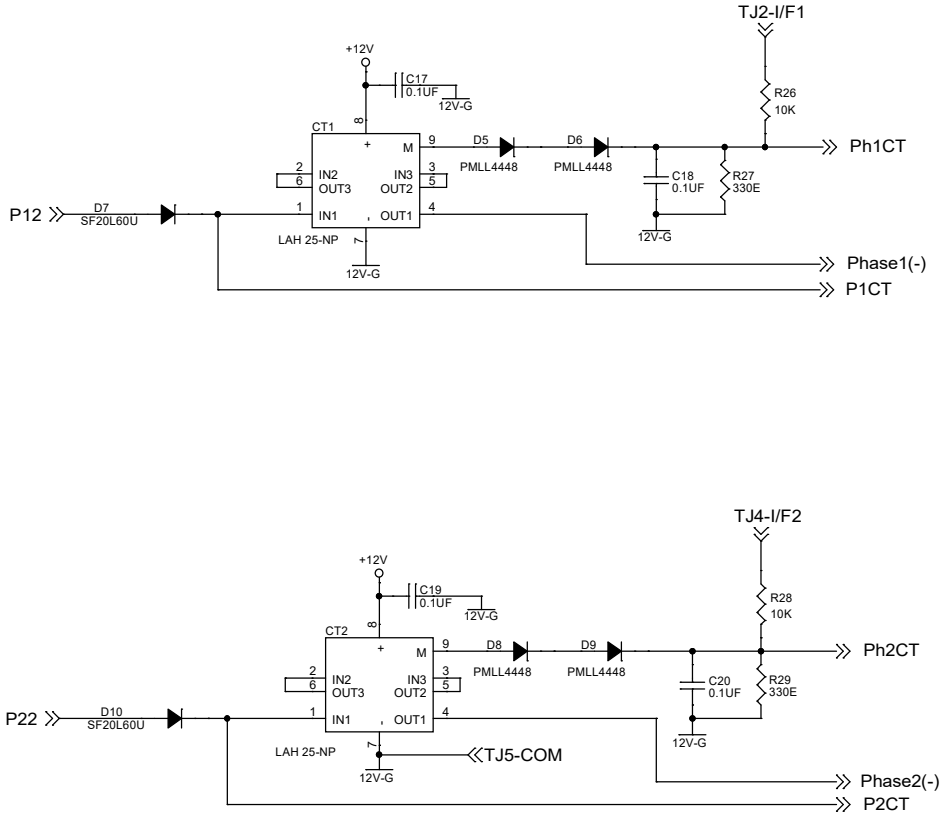
SUB TITLE	TITLE POWER MODULE ELECTRICAL SCHEMATIC			DRG. No.
	DRN	DRG. CHKD.	DES. CHKD.	SHT. 3 OF 11
			CUST DRG No.	REV. 0



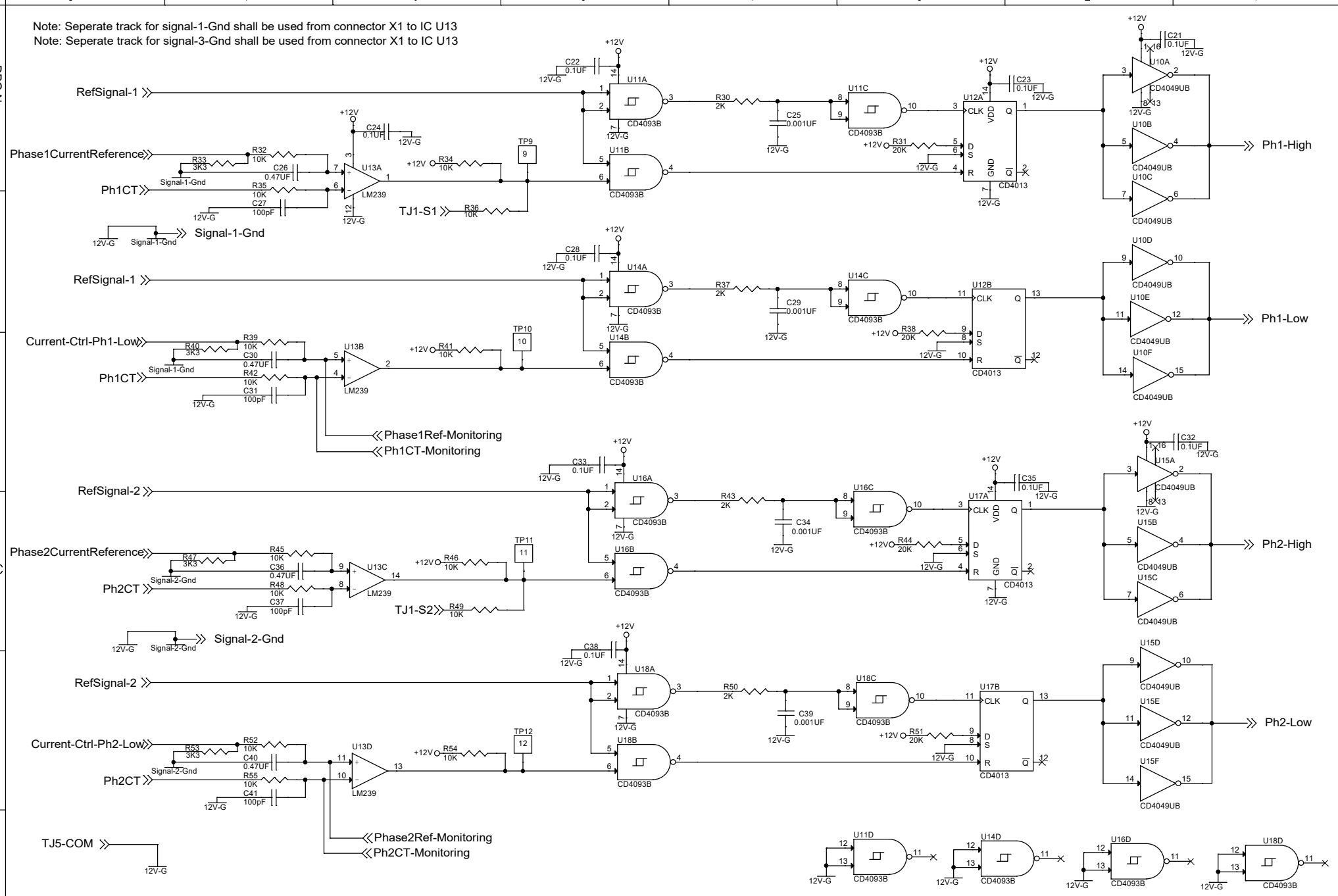
SUB TITLE	TITLE POWER MODULE ELECTRICAL SCHEMATIC		DRG. No.
	DRN / DRG. CHKD. / DES. CHKD.		SHT. 4 OF 11
		CUST DRG No.	REV. 0

DRG.No. SHT. 4 OF 11 REV. 0

Note: CT burdan resistors, R27 and R29 shall be selected as per reference current from control module.

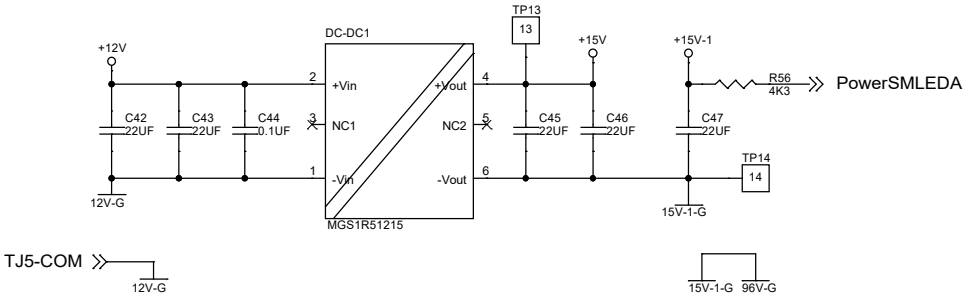


SUB TITLE	TITLE POWER MODULE ELECTRICAL SCHEMATIC			DRG. No.
	DRN	DRG. CHKD.	DES. CHKD.	SHT. 5 OF 11
			CUST DRG No.	REV. 0

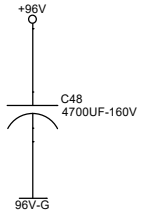


SUB TITLE	TITLE POWER MODULE ELECTRICAL SCHEMATIC		DRG. No.
	DRN / DRG. CHKD. / DES. CHKD.		SHT. 6 OF 11
		CUST DRG No.	REV. 0

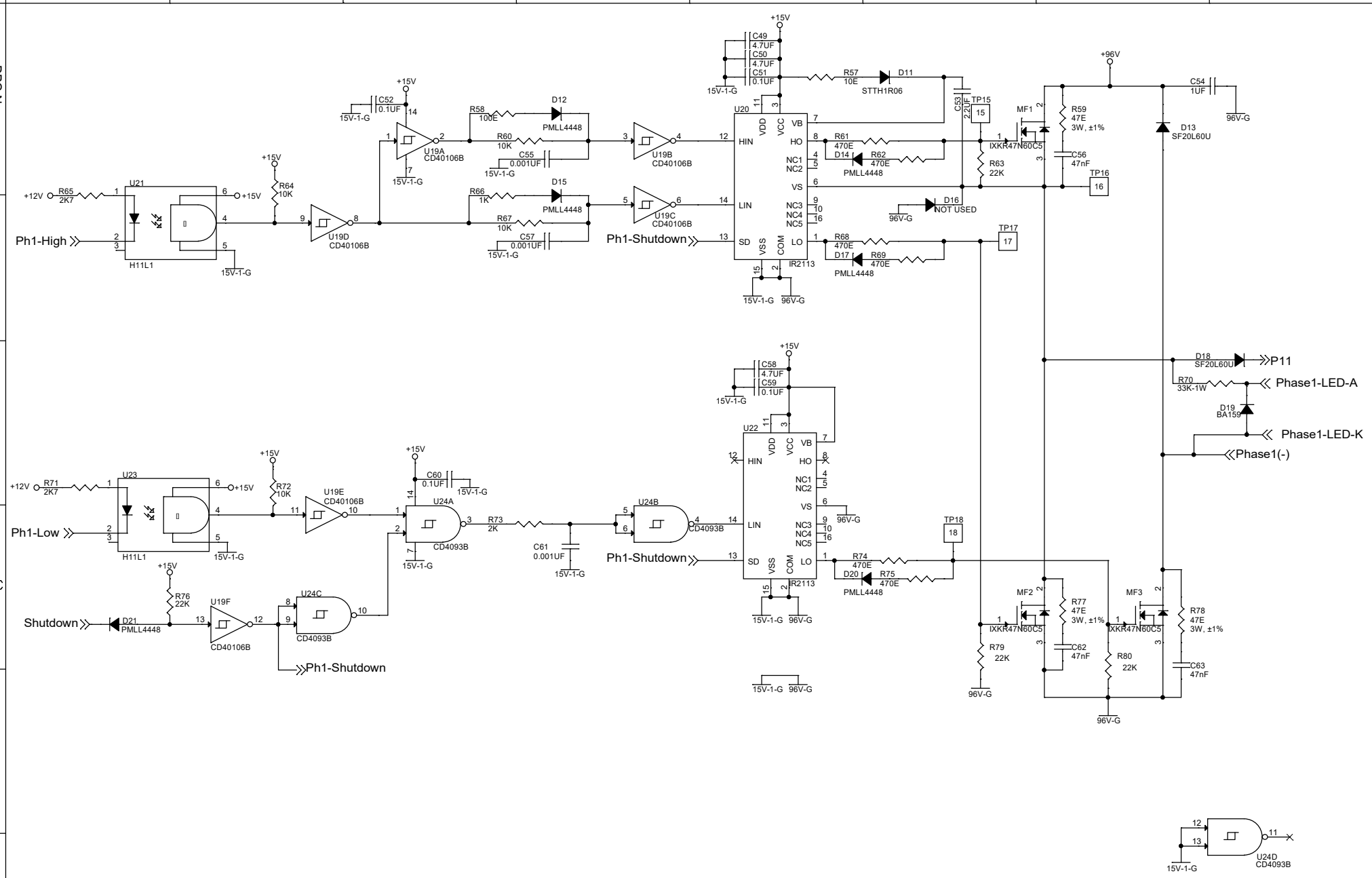
DRG.No. SHT. 6 OF 11 REV. 0



SUB TITLE	TITLE POWER MODULE ELECTRICAL SCHEMATIC		DRG. No.
	DRN / DRG. CHKD. / DES. CHKD.		SHT. 7 OF 11
		CUST DRG No.	REV. 0

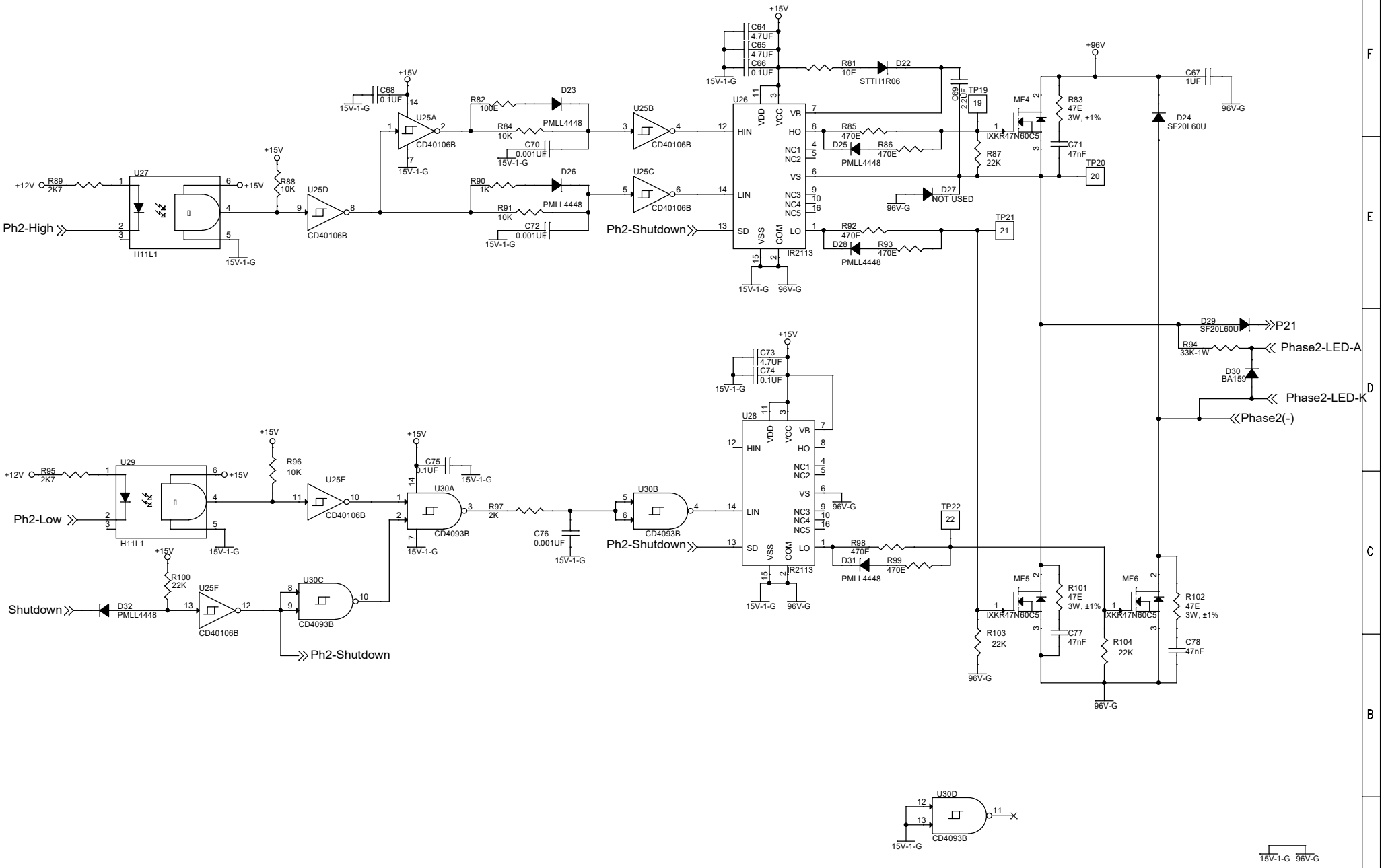


SUB TITLE	TITLE POWER MODULE ELECTRICAL SCHEMATIC			DRG. No.
	DRN	DRG. CHKD.	DES. CHKD.	SHT. 8 OF 11
			CUST DRG No.	REV. 0



SUB TITLE	TITLE POWER MODULE ELECTRICAL SCHEMATIC		DRG. No.
	DRN / DRG. CHKD. / DES. CHKD.		SHT. 9 OF 11
		CUST DRG No.	REV. 0

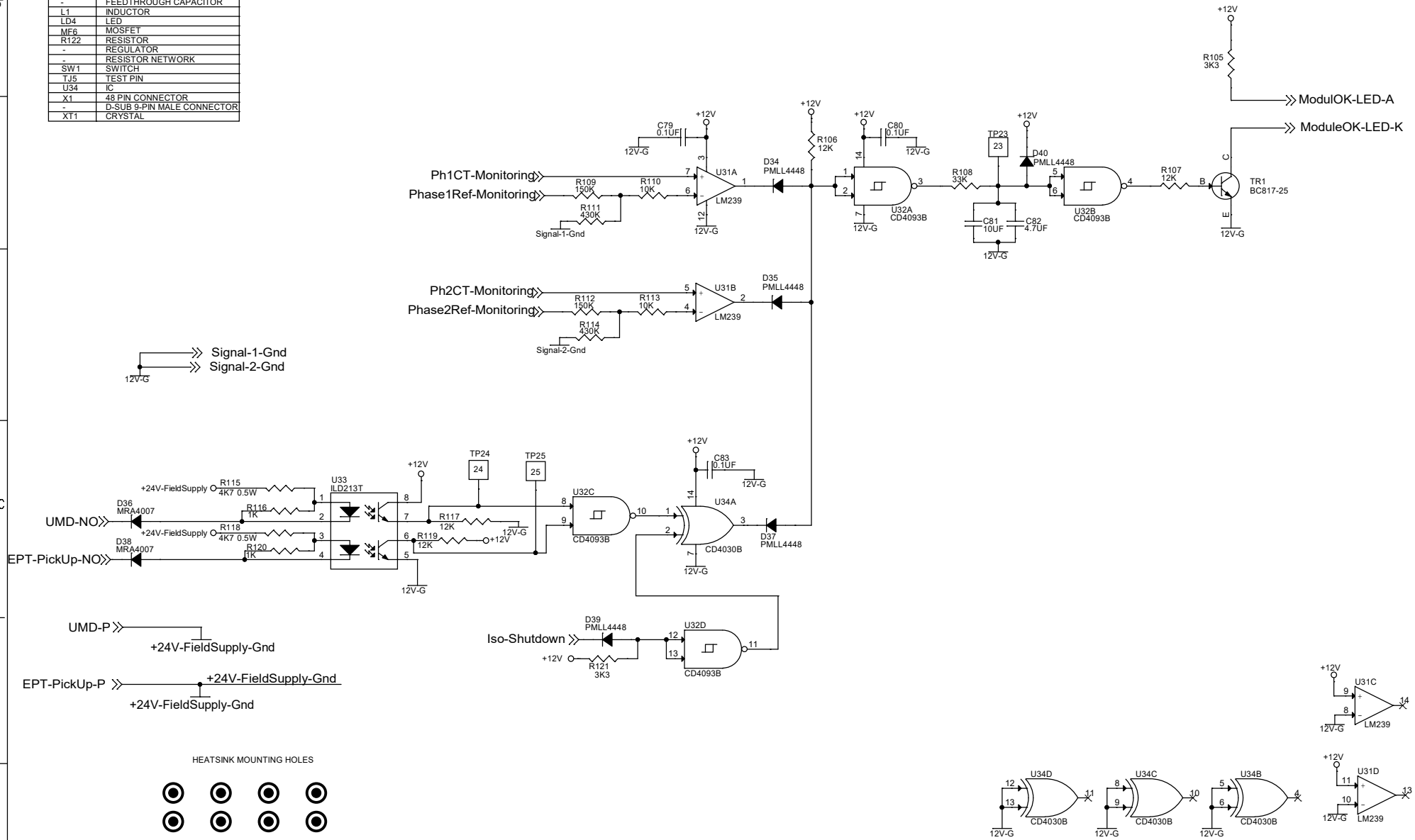
DRG.No.
SHT. 9 OF 11
REV. 0



SUB TITLE	TITLE POWER MODULE ELECTRICAL SCHEMATIC		DRG. No.
	DRN / DRG. CHKD. / DES. CHKD.		SHT. 10 OF 11
		CUST DRG No.	REV. 0

REV. 0 SHT. 10 OF 11 DRG.No.

LAST IDENTITY OF COMPONENTS	
C83	CAPACITOR
X1	PCB CONNECTOR
CT2	CURRENT TRANSDUCER
D40	DIODE
DC-DC1	DC-DC CONVERTER
-	BATTERY
DZ2	ZENER DIODE
-	FEEDTHROUGH CAPACITOR
L1	INDUCTOR
LD4	LED
MF6	MOSFET
R122	RESISTOR
-	REGULATOR
-	RESISTOR NETWORK
SW1	SWITCH
TJ5	TEST PIN
U34	IC
X1	48 PIN CONNECTOR
-	D-SUB 9-PIN MALE CONNECTOR
XT1	CRYSTAL



SUB TITLE	TITLE POWER MODULE ELECTRICAL SCHEMATIC		DRG. No.
	DRN / DRG. CHKD. / DES. CHKD.		SHT. 11 OF 11
		CUST DRG No.	REV. 0

DRG.No. SHT. 11 OF 11 REV. 0

REV. NO.	DATE	REVISIONS / ISSUES	PREPARED	APPROVED
0		ISSUED FOR APPROVAL		

REFERENCE CL	**Power MODULE** BILL OF MATERIAL	
DATE PREPD CHKD APPD		PROJ. NO. **BM-** SHT. 1 OF 6 REV. 0

BM-

ITEM NO.	DESCRIPTION	IDENTITY	QTY	MATL. SPEC./ DRG. NO./ MAKE&TYPE	REMARKS	PROC. REF.
1	PRINTED CIRCUIT	PCB1	1			
2	Current Transducer	CT1,CT2	2	LEM	CT-LAH25	
	LAH 25-NP , 3:1000			LAH 25-NP		
3	Capacitor	C1,C2,C42,C43,C45,C46,C47	7	KEMET	smd 2220	
	22uf / 25V, 10%			C2220C226K3RA		
4	Ceramic Capacitor	C3,C4,C5,C6,C9,C11,C15,C16,C17,C18, C19, C20,C21,C22,C23,C24,C28, C32,C33,C35,C38,C44,C51,C52,C	33	Vishay	smd 1206	
	0.1uf / 50V, 10%			VJ1206Y104KXA		
5	Ceramic Capacitor	C7,C8	2	KEMET	smd 1206	
	22pF 50V, ±5%			C1206C220J5GA		
6	Ceramic Capacitor	C10,C13	2	KEMET	smd 1206	
	1uf / 25V, 10%			C1206C105K3RA		
7	Ceramic Capacitor	C12,C27,C31,C37,C41	5	KEMET	smd 1206	
	100pf / 50V ,10%			C1206C101K5GA		
8	Ceramic Capacitor	C14,C81	2	KEMET	smd 1206	
	10uf / 25V , 10%			C1206C106K3RA		
9	Ceramic Capacitor	C25,C29,C34,C39,C55,C57,C61,	10	KEMET	smd 1206	
	0.001uf / 25V , 5%	C70,C72,C76		C1206C102J5GA		
10	Ceramic Capacitor	C26,C30,C36,C40	4	KEMET	smd 1206	
	0.47uf / 25V , 10%			C1206C474K3RA		
11	Ceramic Capacitor	C49,C50,C58,C64,C65,C73,C82	7	KEMET	smd 1206	
	4.7uf / 25V , 10%			C1206C475K3RA		
12	Ceramic Capacitor	C53,C69	2	KEMET	smd 1206	
	2.2uf / 25V , 10%			C1206C225K3RA		
13	Electrolytic capacitor	C56,C62,C63,C71,C77,C78	6	Vishay	AXIAL MOUNT	
	47nf / 400V , 2%			MKP1839347404	THROUGH	
14	Axial Capacitor	C54,C67	2		Axial Mount	
	1uf/160V , 1%			MKP1839510164	Through hole	
15	DC-DC Converter	DC-DC1	1	Cosel	THROUGH	
	I/p 9-18V, O/p 15V, 1.5W			MGS1R51215	SIP - 8	
16	Zener Diode	DZ1,DZ2	2	Vishay	SMD	
				BZD27C5V1P	DO-219AB	
17	Diode	D1,D3,D4,D33,D36,D38	6	On Semi		
	SMD: DO-214AC			MRA4007T3G		

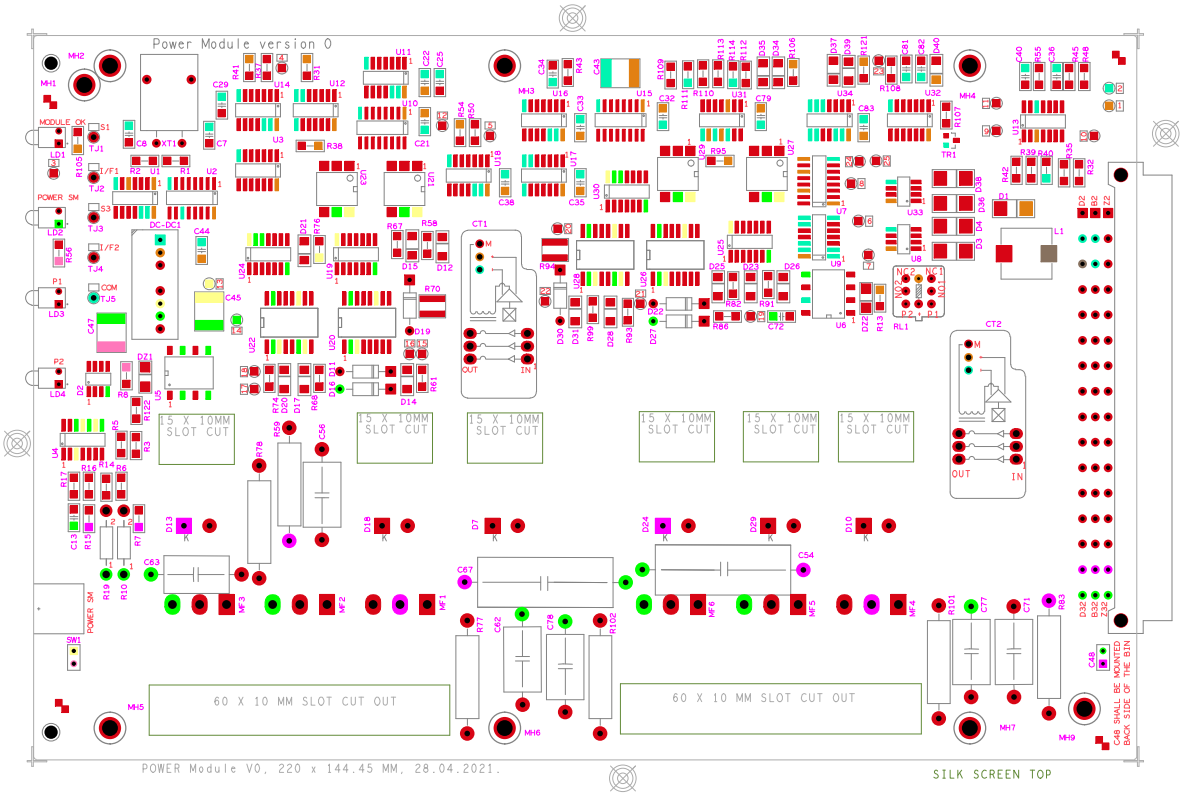
DRN	CHKD	CUST. REF.	BM-
			SHT. 2 OF
			REV. 0

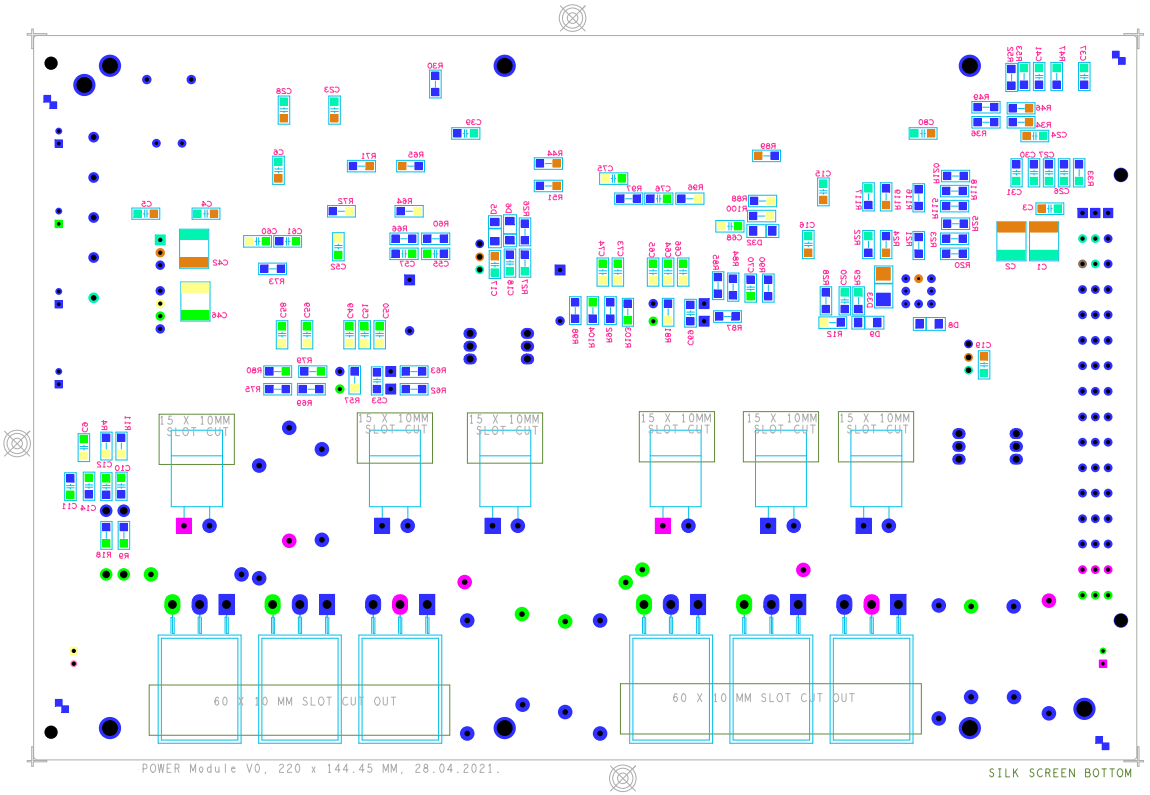
ITEM	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./	REMARKS	PROC.
NO.				DRG. NO./		REF.
18	Reference Diode	D2	1	Texas instrument	SOIC 8	SOIC-
				LM236D-2.5V	D package	narrow
19	Diode	D5,D6,D8,D9,D12,D14,D15,	21	NXP Semiconductors		
		D20,D21,D23,		PMLL4448 , SMD SOD80		
		D32,D34,D35,D37,D39,D40				
20	Diode	D7,D10,D13,D18,D24,D29	6	Shindengen		
				SF20L60U package: FTO-		
21	Rectifier	D11,D22	2	STMicroelectronics		
				STTH1R06 DO-41		
22	Diode	D19,D30	2	BA159 , DO-204AL (DO-		
				PACKAGE , THROUGH		
23	Light Emitting Diode	LD1,LD2,LD3,LD4 (GREEN)	4			
	dia-3mm, pitch-					
24	Differential Mode	L1	1	VISHAY		
	22uH, 5 Amp			IHLP4040DZER220M11		
25	Power Mosfet	MF1,MF2,MF3,MF4,MF5,MF	6	IXYS		
				IXKR47N60C5		
				ISOPLUS247 package		
26	diode	D16, D17		Not used		
27	Relay	RL1	1	TE Connectivity		
				MGAP-12		
28	Resistor	R1,R111,R114	3	ROHM Semiconductor		
	100K 0.25W, ±1%			KTR18EZPF1003 SMD :		
29	Resistor	R111,R114		ROHM Semiconductor		
	430K 0.25W, ±1%			KTR18EZPF4303 SMD :		
30	Resistor	R2	1	ROHM Semiconductor		
	5k6 0.25W, ±1%			KTR18EZPF5601 SMD :		
31	Resistor	R3	1	ROHM Semiconductor		
	68k 0.25W, ±1%			KTR18EZPF6802 SMD :		
32	Resistor	R4,R12	2	ROHM Semiconductor		
	3k9 0.25W, ±1%			KTR18EZPF3901 SMD :		
33	Resistor	R5	1	ROHM Semiconductor		
	15k 0.25W, ±1%			KTR18EZPF1502 SMD :		
	DRN CHKD	CUST. REF.			BM-	
					SHT. 3 of 6	
					REV. 0	

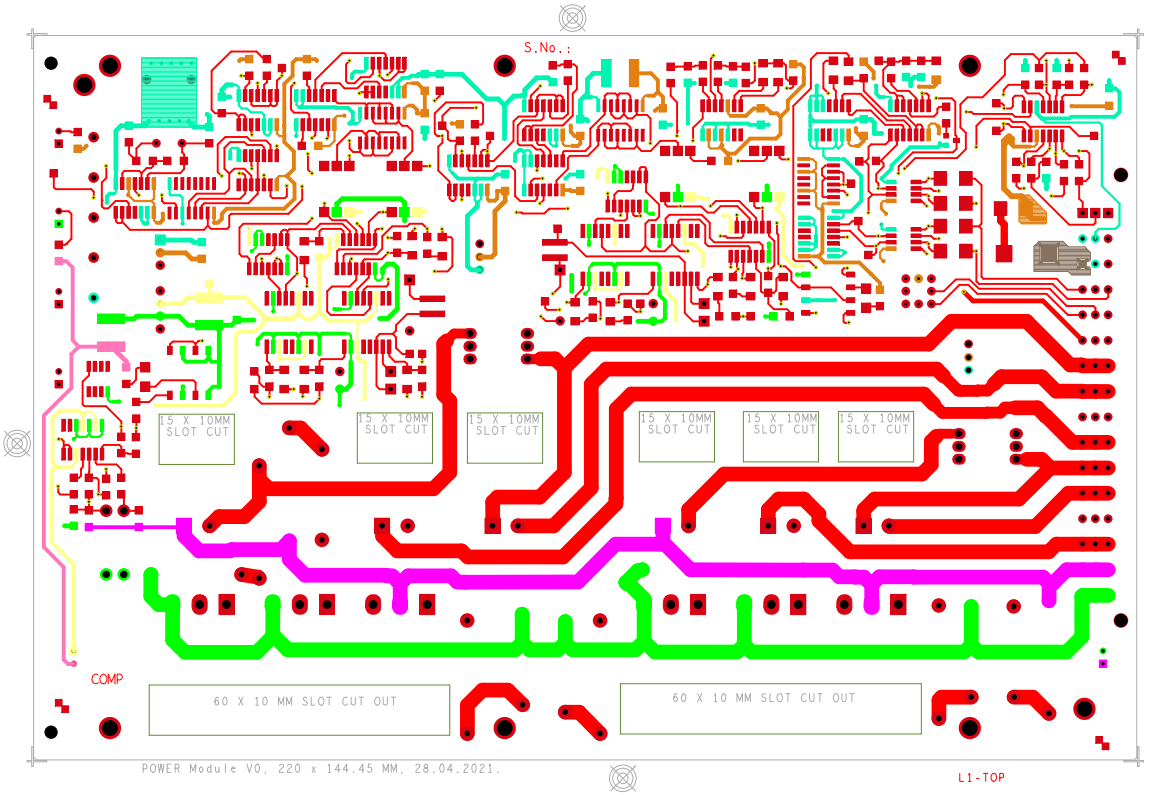
ITEM	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./	REMARKS	PROC.
						REF.
34	Resistor	R6,R16,R17,R22,R24,R26,R28, R32, R34,R39,R41,R42, R45, R46, R48, R49, R52, R54, R55, R60, R64, R67, R84,	31	ROHM Semiconductor		
	10k 0.25W, ±1%			KTR18EZPF1002 SMD :		
35	Resistor	R8,R9,R65,R71,R89,R95	6	ROHM Semiconductor		
	2k7 0.25W, ±1%			KTR18EZPF2701 SMD :		
36	SOT(resistor placing)	R10,R19	2	CHANDSON		
37	Resistor	R13	1	ROHM Semiconductor		
	1k5 0.25W, ±1%			KTR18EZPF1501 SMD :		
38	Resistor	R11	1	ROHM Semiconductor		
	2k2 0.25W, ±1%			KTR18EZPF2201 SMD :		
39	Resistor	R14	1	ROHM Semiconductor		
	150k 0.25W, ±1%			KTR18EZPF1503 SMD :		
40	Resistor	R18	1	ROHM Semiconductor		
	3k6 0.25W, ±1%			KTR18EZPF3601 SMD :		
41	Resistor	R20, R23, R115, R118	4	ROHM Semiconductor		
	4k7 0.5W, ±1%			ESR18EZPF4701 SMD :		
42	Resistor	R21, R25, R66, R90, R116, R120	6	ROHM Semiconductor		
	1k 0.25W, ±1%			KTR18EZPF1001 SMD :		
43	Resistor	R27,R29	2	ROHM Semiconductor		
	330E 0.25W, ±1%			KTR18EZPF3300 SMD :		
44	Resistor	R30,R37,R43,R50,R73,R97, R122	7	ROHM Semiconductor		
	2k 0.25W, ±1%			KTR18EZPF2001 SMD :		
45	Resistor	R31,R38,R44,R51	4	ROHM Semiconductor		
	20k 0.25W, ±1%			KTR18EZPF2002 SMD :		
46	Resistor	R33,R40,R47,R53,R105,	6	ROHM Semiconductor		
	3k3 0.25W, ±1%			KTR18EZPF3301 SMD :		
47	Resistor	R56	1	ROHM Semiconductor		
	4k3 0.25W, ±1%			KTR18EZPF4301 SMD :		
48	Resistor	R57,R81	2	ROHM Semiconductor		
	10E 0.25W, ±1%			KTR18EZPF10R0 SMD :		
49	Resistor	R58,R82	2	ROHM Semiconductor		
	100E 0.25W, ±1%			KTR18EZPF1000 SMD :		
	DRN CHKD	CUST. REF.			BM-	
					SHT. 4 of 6	
					REV. 0	

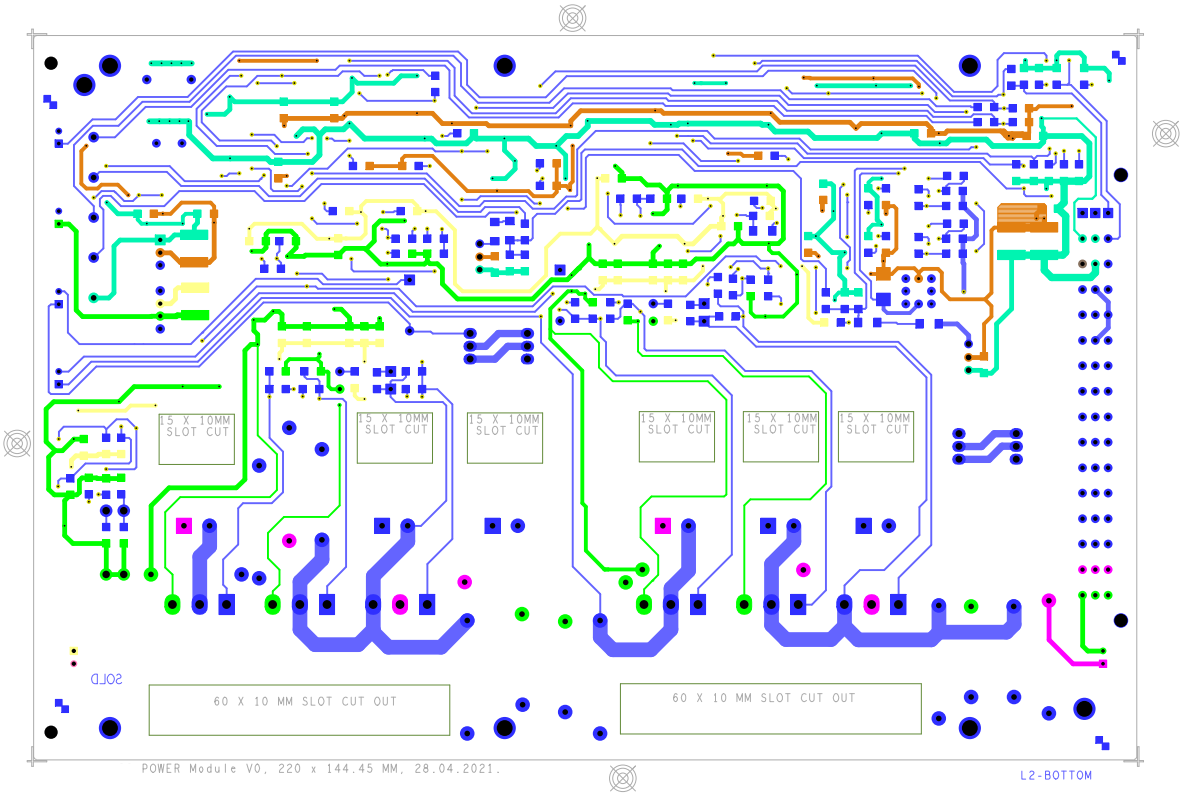
ITEM	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./	REMARKS	PROC.
						REF.
50	Resistor	R59,R77,R78,R83,R101,	6	VISHAY		
	47E 3W, ±2% ,			CPF347R000GKB14		
51	Resistor	R61,R62,R68,R69,R74,R	12	ROHM Semiconductor		
	470E 0.25W, ±1%	75,		KTR18EZPF4700 SMD : 1206		
52	Resistor	R63,R76,R79,R80,R87,R	8	ROHM Semiconductor		
	22K 0.25W, ±1%	100, R103,R104		KTR18EZPF2202 SMD : 1206		
53	Resistor	R106,R107,R117,R119	4	ROHM Semiconductor		
	12K 0.25W, ±1%			KTR18EZPF1202 SMD :		
54	Resistor	R109,R112	2	ROHM Semiconductor		
	150K 0.25W, ±1%			KTR18EZPF1503 SMD : 1206		
55	Resistor	R7,R15	2	TE Connectivity		
	100K , 0.5W, ±1%			CRGP1206F100K		
56	Resistor	R108	1	ROHM Semiconductor		
	33K 0.25W, ±1%			KTR18EZPF3302 SMD : 1206		
57	Resistor	R70,R94	2	Vishay		
	33K/1W, ±1%			RCL121833K0FKEK		
58	Miniture Toggle	SW1	1	NKK SWITCHES		
	DPDT Switch			M2022 SS1A01		
59	testpoint	TP1-TP25	25	2mm X 2 mm copper on PCB		
60	testpoint	TJ1-TJ5	5	Mittal electronics (ME-47)		
61	NPN Transistor	TR1	1	Diodes Incorporated		
	BC817-25 ,			BC817-25 SMD : SOT23		
62	Quad Two Input	U1	1	TEXAS INSTRUMENTS		
	CD4011B , 14 PIN			CD4011BM , SOIC 14	SOIC-14N	
63	RIPPLE-CARRY	U2	1	TEXAS INSTRUMENTS	SOIC-16N	
	CD4040 , 16 PIN			CD4040BM		
64	Dual Quad Input	U3	1	TEXAS INSTRUMENTS	SOIC-14N	
	CD4012 , 14 PIN			CD4012BM , SOIC 14		
65	QUAD	U4,U13,U31	3	TEXAS INSTRUMENTS	SOIC-14N	
	LM239 , 14 PIN IC			LM239 , SOIC 14		
66	DUAL (B) SOLID	U5,U6	2	IXYS		
	LBB127S			LBB127S , SMD Package		
	DRN CHKD	CUST. REF.			BM-	
					SHT. 5 of 6	
					REV. 0	

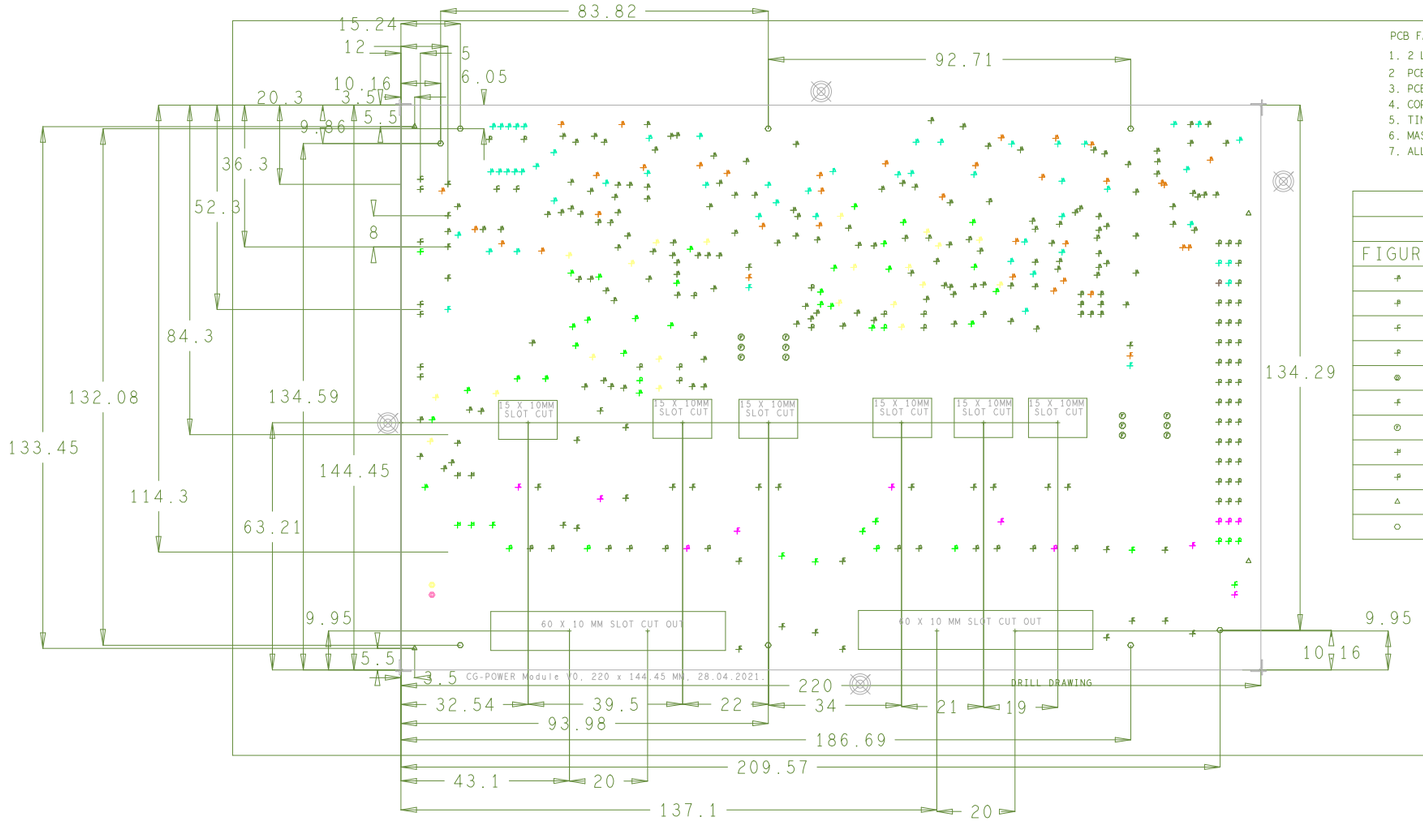
ITEM	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./	REMARKS	PROC.
						REF.
67	CMOS Hex Inverting	U7,U10,U15	3	TEXAS INSTRUMENTS	SOIC-16N	narrow package
	CD4049UB			CD4049UB, SOIC-16	D pakage	
68	Optocoupler	U8,U33	2	VISHAY	SO8-OPTO-	smd package
	ILD213T , 8 PIN IC			ILD213T, SOIC 8		
69	QUAD TWO INPUT	U9,U11,U14,U16,	8	TEXAS INSTRUMENTS	SOIC-14N	narrow package
	CD4093B , 14 PIN	U18,U24,U30,		CD4093BM, SOIC 14		
70	DUAL D-TYPE FLIP-	U12,U17	2	TEXAS INSTRUMENTS	SOIC-14N	narrow package
	CD4013 , 14 PIN IC			CD4013BM, SOIC 14		
71	MOSFET DRIVER	U20,U22,U26,U2	4	IR	SOIC-16W	wide package
	IR2113 , 16 PIN IC			IR2113SPbF, SOIC 16		
72	CMOS HEX	U19,U25	2	TEXAS INSTRUMENTS	SOIC-14N	narrow package
	CD40106B , 14			CD40106BM, SOIC 14		
73	PHOTOCOUPLER	U21,U23,U27,U2	4	FAIRCHILD	SMD	SO6-OPTO-2P54
	H11L1 , 6 PIN IC			H11L1SM , SMD	6-pin DIP	
74	QUAD TWO INPUT	U34	1	TEXAS INSTRUMENTS	SOIC-14N	narrow package
	CD4030B , 14 PIN			CD4030, SOIC 14		
75	Quartz crystal	XT1	1	Andhra Electronics	Through hole	
	1.8432 MHz			49U2FIK133P001M8432	2 PIN PROFILE	
76	Connector	X1	1	HARTING		
	48 pin MALE			09061487901		
77	Connector	X2	1	HARTING		
	48 pin FEMALE			09062486823		
	DRN CHKD	CUST. REF.			BM-	
					SHT. 6 of 6	
					REV. 0	


Power Module version 0
15 X 10MM SLOT CUT
60 X 10 MM SLOT CUT OUT
POWER Module V0, 220 x 144.45 MM, 28.04.2021.
SILK SCREEN TOP
C48 SHALL BE MOUNTED BACK SIDE OF THE BIN


15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
60 X 10 MM SLOT CUT OUT
60 X 10 MM SLOT CUT OUT
POWER Module V0, 220 x 144.45 MM, 28.04.2021.
SILK SCREEN BOTTOM


S.No.:
15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
COMP
60 X 10 MM SLOT CUT OUT
60 X 10 MM SLOT CUT OUT
POWER Module V0, 220 x 144.45 MM, 28.04.2021.
L1-TOP


15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
15 X 10MM SLOT CUT
SOLD
60 X 10 MM SLOT CUT OUT
60 X 10 MM SLOT CUT OUT
POWER Module V0, 220 x 144.45 MM, 28.04.2021.
L2-BOTTOM



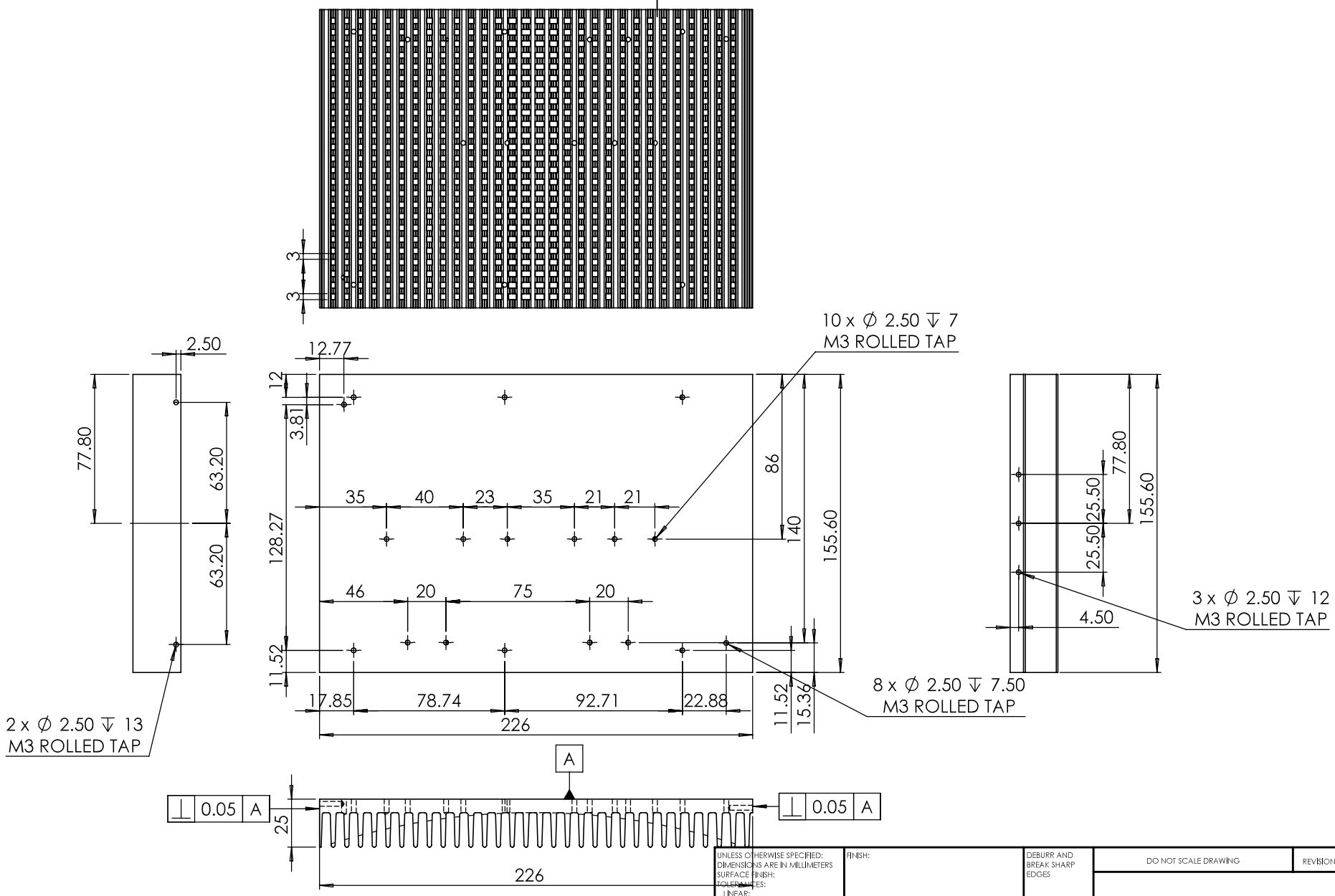
PCB FAB DETAILS:

1. 2 LAYER PCB
2. PCB MATERIAL : FR4 GLASS EPOXY
3. PCB THICKNESS 1.6 MM
4. COPPER THICKNES 70 MICRONS
5. TINNING ENIG
6. MASKING GREEN
7. ALL DIMENSIONS ARE IN MM

DFM ANALYSIS(MM)		
MIN AIRGAP	PAD/PAD	0.3
	PAD/TRACE	0.3
	TRACE/TRACE	0.3
MIN. TRACE WIDTH		0.4
MIN. F.H.S FOR PTH		0.5
IMPEDANCE		NO

DRILL CHART: TOP to BOTTOM			
ALL UNITS ARE IN MILLIMETERS			
FIGURE	FINISHED_SIZE	PLATED	QTY
+	0.5	PLATED	278
+	0.7	PLATED	8
+	0.8	PLATED	12
+	1.0	PLATED	69
⊗	1.0	PLATED	2
+	1.2	PLATED	51
⊗	1.5	PLATED	12
+	1.6	PLATED	4
+	1.8	PLATED	18
△	2.7	PLATED	4
○	3.2	PLATED	8

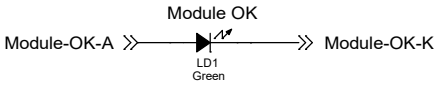
TITLE: POWER MODULE	REV.
DESCRIPTION:	

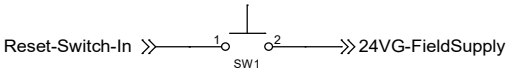


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION 1.2		
	NAME	SIGNATURE	DATE	TITLE: Power Module Heat Sink		
DRAWN			29/12/20			
CHK'D						
APP'V'D						
MFG						
Q.A	1			MATERIAL: AL	DWG NO.	A3
				WEIGHT: 401.33	SCALE:1:2	SHEET 1 OF 1

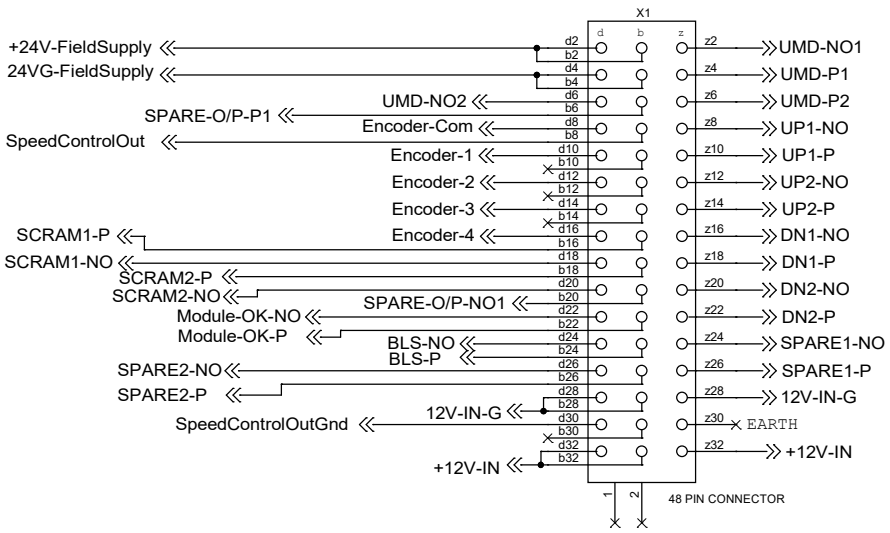
5. Control command module

Front Facia





Back Facia



TITLE: Command Control Module
ELECTRICAL SCHEMATIC

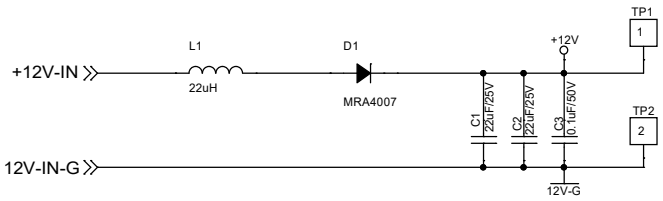
DRN | DRG. CHKD. | DES. | DES. CHKD. | APPD.
PROJ. NO.
CUST DRG No.
SHT. 1 OF 6
REV. 0

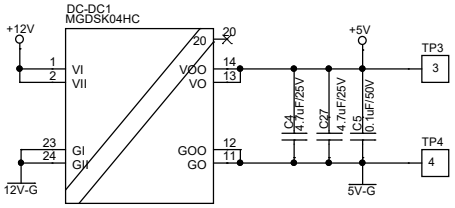
GENERAL ARRANGEMENT
BILL OF MATERIAL
TITLE
DRG.No.
REFERENCE DRAWINGS
SCALE: PROJECTION
ALL DIMENSIONS ARE IN mm UNLESS STATED
OTHERWISE GENERAL TOLERANCE ANGLES ± 1/2°
FULL NOS. ±1 1 DEC.PLACE ±0.5
DEC.PLACE ±0.05 3 DEC.PLACE ±0.005

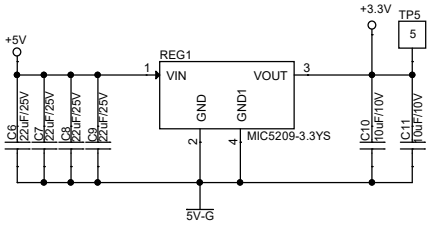
ISSUE NO.	REV NO.	APPROVAL	ISSUED FOR	PROJ.No.	ISSUE SHT.No.	DATE	APPD.
2 1	0						

No. LOC	REVISION DESCRIPTION	DRN DATE	APPD

DRG.NO.
SHT. 1 OF 6
REV. 0







DRG. No.

SHT. 2 OF 6

REV. 0

CUST DRG No.

TITLE

Command Control Module

ELECTRICAL SCHEMATIC

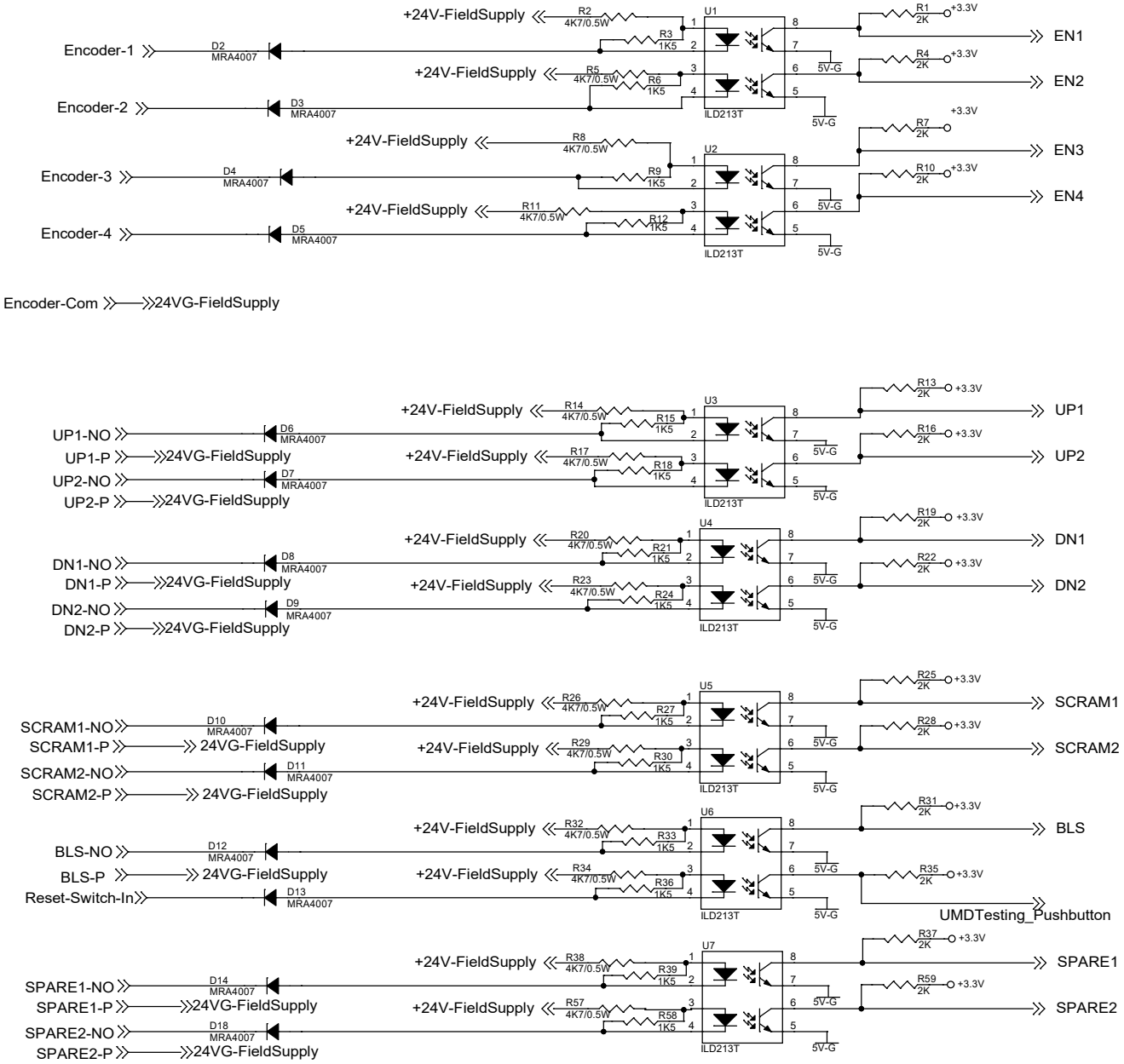
DRN | DRG. CHKD. | DES. CHKD.

SUB TITLE

DRG.NO.

SHT. 2 OF 6

REV. 0



DRG. No.

SHT. 3 OF 6

REV. 0

CUST DRG No.

TITLE

Command Control Module
ELECTRICAL SCHEMATIC

DES. CHKD.

DRG. CHKD.

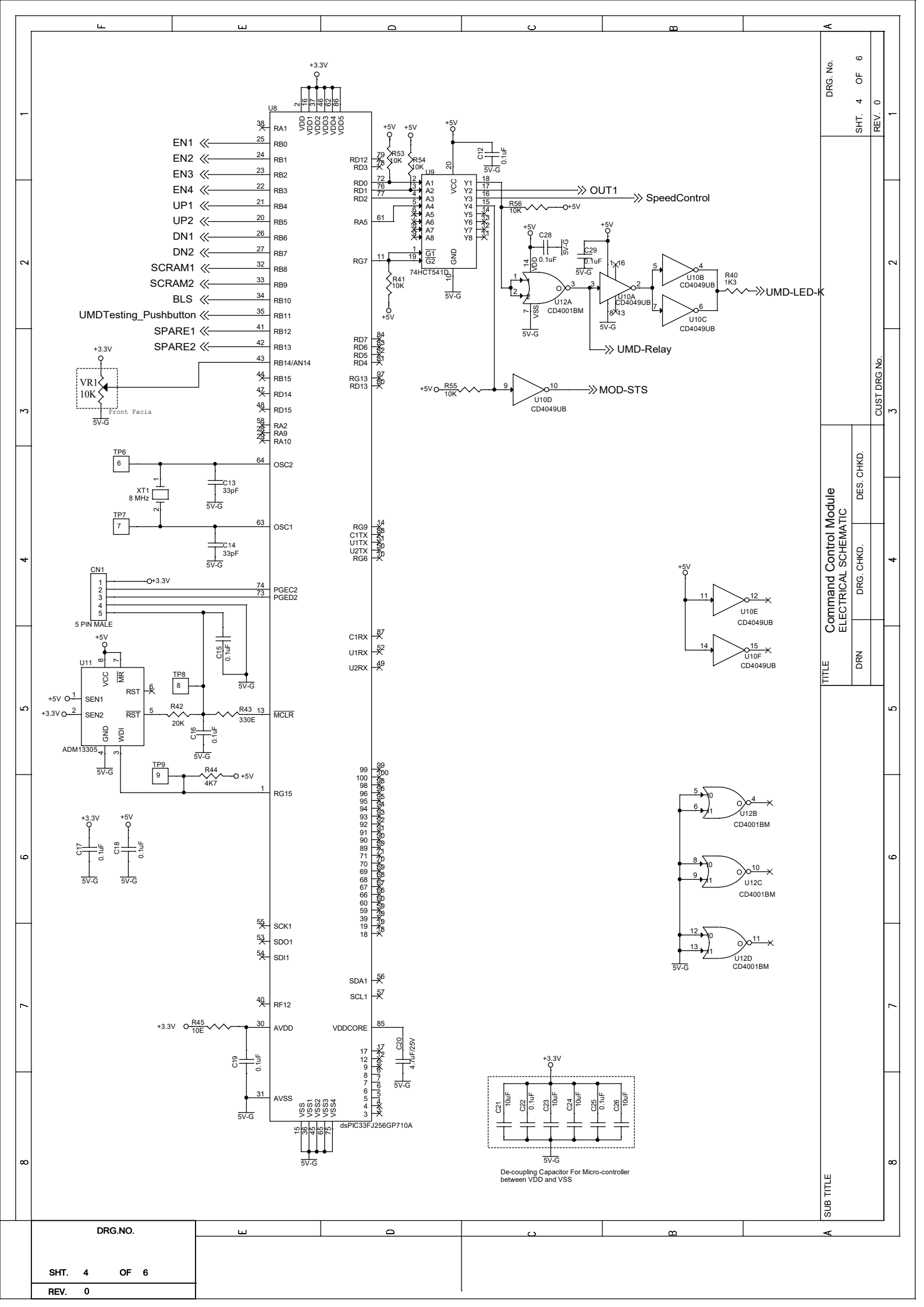
DRN

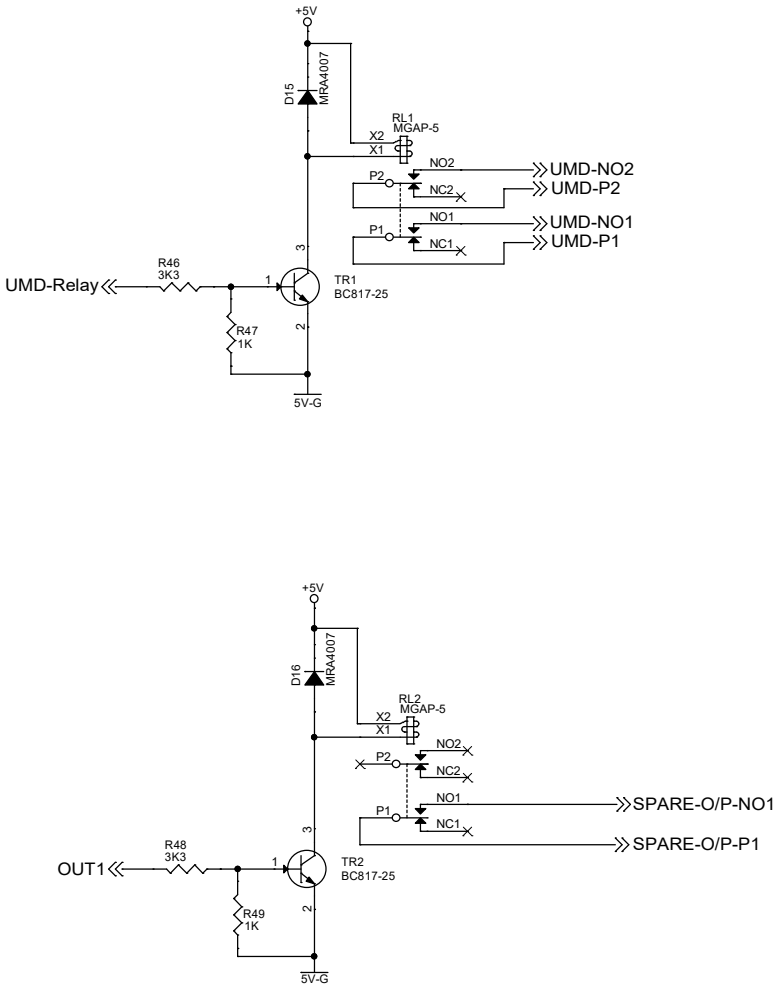
SUB TITLE

DRG.NO.

SHT. 3 OF 6

REV. 0


EN1
EN2
EN3
EN4
UP1
UP2
DN1
DN2
SCRAM1
SCRAM2
BLS
UMDTesting_Pushbutton
SPARE1
SPARE2
OUT1
SpeedControl
UMD-LED-K
UMD-Relay
MOD-STS
U8
dsPIC33FJ256GP710A
U9
74HCT541D
U10A CD4049UB
U10B CD4049UB
U10C CD4049UB
U10D CD4049UB
U10E CD4049UB
U10F CD4049UB
U12A CD4001BM
U12B CD4001BM
U12C CD4001BM
U12D CD4001BM
U11
ADM13305
CN1
5 PIN MALE
XT1
8 MHz
VR1
10K
Front Facia
De-coupling Capacitor For Micro-controller
between VDD and VSS
DRG. No.
SHT. 4 OF 6
REV. 0
CUST DRG No.
TITLE
Command Control Module
ELECTRICAL SCHEMATIC
DES. CHKD.
DRG. CHKD.
DRN
SUB TITLE
DRG.NO.
SHT. 4 OF 6
REV. 0



DRG. No.

SHT. 5 OF 6

REV. 0

CUST DRG No.

TITLE

Command Control Module

ELECTRICAL SCHEMATIC

DES. CHKD.

DRG. CHKD.

DRN

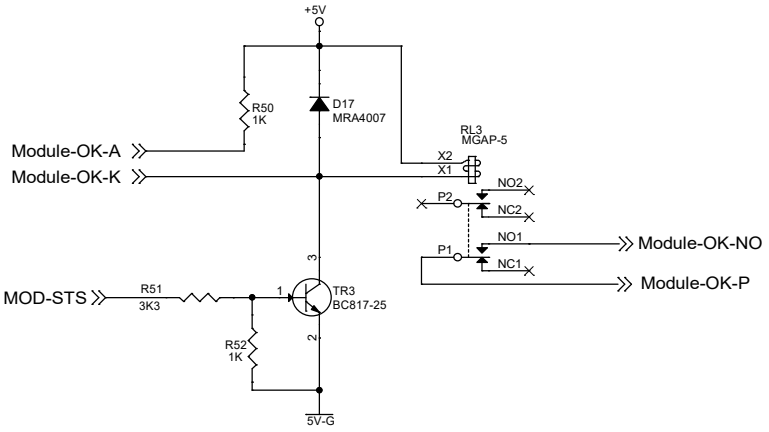
SUB TITLE

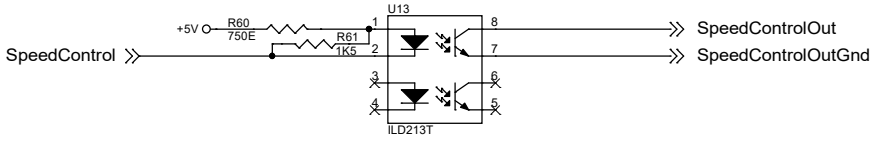
DRG.NO.

SHT. 5 OF 6

REV. 0

LAST IDENTITY OF COMPONENTS	
C29	CAPACITOR
X1	CONNECTOR
D18	DIODE
DC-DC1	DC-DC CONVERTER
L1	INDUCTOR
LD2	LED
R62	RESISTOR
TR3	TRANSISTOR
TP9	TEST PIN
U13	IC
REG1	REGULATOR
XT1	CRYSTAL
X1	48 PIN CONNECTOR
RL3	RELAY





DRG. No.

SHT. 6 OF 6

REV. 0

CUST DRG No.

TITLE

Command Control Module
ELECTRICAL SCHEMATIC

DES. CHKD.

DRG. CHKD.

DRN

SUB TITLE

DRG.NO.

SHT. 6 OF 6

REV. 0

REV. NO.	DATE	REVISIONS / ISSUES	PREPARED	APPROVED
0		ISSUED FOR APPROVAL		

REFERENCE CL	**Control Command Module** BILL OF MATERIAL	
DATE		PROJ. NO.
PREPD		**BM-**
CHKD		SHT. 1 OF 4
APPD		REV. 0

BM-

ITEM	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./	remark
NO.				DRG. NO./	
				MAKE&TYPE	
1	PRINTED CIRCUIT BOARD	PCB1	1		
2	CONNECTOR	CN1	1	MOLEX	
				22-29-2051	
3	Capacitor	C1,C2,C6,C7,C8,C9	6	KEMET	
	22uF/25V , 10% , smd:2220			C2220C226K3RACTU	
4	Capacitor	C3,C5	2	Vishay	
	0.1uf/50V,10%, smd:1206			VJ1206Y104KXAAT	
5	Capacitor	C4,C27,C20	3	KEMET	
	4.7µF/25V, 10%, smd:1206			C1206C475K3RACTU	
6	Capacitor	C10,C11,C21,C23,C24,	6	KEMET	
	10uF/10V,10%,smd:1206			C1206C106K8RALTU	
7	Capacitor	C12,C15,C16,C17,C18,	10	KEMET	
	0.1uF/25V, 10%, smd:1210	C19,C22,C25,C28,C29		C1210C104K3RACTU	
8	CERAMIC CAPACITOR	C13,C14	2	KEMET	
	33pF 50V, ±5% , SMD : 1206			C1206C330J5GAC	
9	DC-DC Converter	DC-DC1	1	GAIA	
	I/p 9-36V, O/p 5V, 4W			MGDSK04HC	
10	Diode	D1 to D18	18	On Semi	
	SMD: DO-214AC package			MRA4007T3G	
12	Light Emiting Diode Green	LD1	1		
	Dia-3mm Pitch-2.5mm				
13	Light Emiting Diode RED	LD2	1		
	Dia-3mm Pitch-2.5mm				
14	Differential Mode Choke	L1	1	VISHAY	
	22uH , 5A			IHLP4040DZER220M11	
15	Regulator	REG1	1	Microchip Technology /	
	3.3V 0.5A 4-Pin (3+Tab)			MIC5209-3.3YS-TR	
	SOT-223			SMD/SMT, SOT-223-3	
16	Relay	RL1,RL2,RL3	3	TE Connectivity	
	5V DC			MGAP-5	
17	Resistor	R1,R4,R7,R10,R13,R16,	14	ROHM Semiconductor	
	2K ,0.25W, ±1%	R22,R25,R28,R31,R35,		KTR18EZPF2001	
	DRN CHKD	CUST. REF.			BM-
					SHT. 2 of 4
					REV. 0

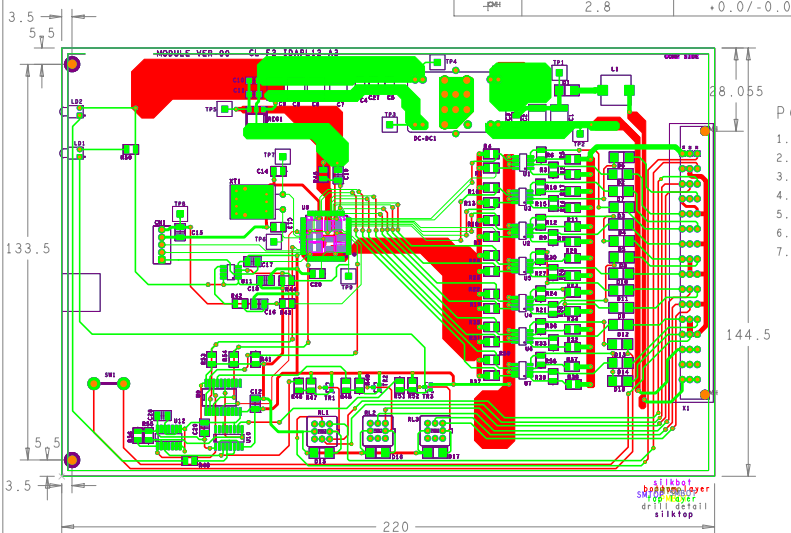
ITEM	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./	REMARKS
NO.				DRG. NO./	
				MAKE&TYPE	
18	Resistor	R2,R5,R8,R11,R14,R17,R20,	14	ROHM Semiconductor	
	4k7/0.5W , ±1%	R23,R26,R29,R32,R34,R38,R57		ESR18EZPF4701 SMD : 1206	
19	Resistor	R44	1	ROHM Semiconductor	
	4k7/0.25W ,±1%			KTR18EZPF4701 SMD : 1206	
20	Resistor	R3,R6,R9,R12,R15,R18,R21,R24,	15	ROHM	
	1k5,0.25W,±1%	R27,R30,R33,R36,R39,R58,R61		KTR18EZPF1501 SMD : 1206	
21	Resistor	R40	1	YAGEO	
	1K3 0.25W, ±1%			AC1206FR-071K3L SMD :	
22	Resistor	R41,R53,R54,R55,R56	5	ROHM Semiconductor	
	10K ,0.25W, ±1%			KTR18EZPF1002 SMD : 1206	
23	Resistor	R42	1	ROHM Semiconductor	
	20K 0.25W, ±1%			KTR18EZPF2002 SMD : 1206	
24	Resistor	R43	1	ROHM Semiconductor	
	330E ,0.25W, ±1%			KTR18EZPF3300 SMD : 1206	
25	Resistor	R45	1	ROHM Semiconductor	
	10E ,0.25W, ±1%			KTR18EZPF10R0 SMD :	
26	Resistor	R46,R48,R51	3	ROHM Semiconductor	
	3K3 , 0.25W, ±1%			KTR18EZPF3301 SMD :	
27	Resistor	R47,R49,R50,R52	4	ROHM Semiconductor	
	1K ,0.25W, ±1%			KTR18EZPF1001 SMD : 1206	
28	Resistor	R60	1	Vishay	
	750E ,0.25W, ±1%			CRCW1206750RFKEAC	
29	Push Button Switch	SW1	1	KNITTER-SWITCH	
	Normaly Open			MPE 206R	
30	Test Point	TP1-TP9	9	2mm X 2 mm copper on PCB	
31	NPN Transistor	TR1,TR2,TR3	3	Diodes Incorporated	
	BC817-25			BC817-25	
	45V,1.5A			SMD : SOT23	
32	Optocoupler	U1,U2,U3,U4,	8	VISHAY	
	8 PIN IC, SMD	U5,U6,U7, U13		ILD213T , SOIC 8	
33	16-bit Digital Signal	U8	1	Microchip	
	Controllers			100 pin IC - TQFP (14x14x1mm)	
	dsPIC33FJ256GP710A			100-Lead Plastic Thin Quad	
	DRN CHKD APPD	CUST. REF.			BM-
					SHT. 3 of 4
					REV. 0

ITEM	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./	REMARKS
NO.				DRG. NO./	
34	Octal buffer/line driver; 3-state	U9	1	NXP (PHILIPS)	NAME : SO20
	74HCT541D			74HCT541D , SOIC 20	Body width-7.5mm
					ver: SOT163-1
35	CMOS HEX INVERTING BUFFER AND CONVE	U10	1	TEXAS INSTRUMENTS	Narrow
	CD4049UB			CD4049UB , SOIC 16	SOIC-16N
36	DUAL PROCESSOR SUPERVISORS WITH W	U11	1	ANALOG DEVICE.	Narrow package
	ADM13305			ADM13305-33ARZ	
				SOIC 8	
37	QUARTZ CRYSTAL	XT1	1	ANDHRA ELECTRONICS	
	8 MHz			49U2FIH133P008M000000	
38	Connector	X1	1	HARTING	
	48 Pin MALE Connector			09061487901	
39	Connector	X2	1	HARTING	
	48 Pin FEMALE Connector			09062486823	
40	QAUD Two input NOR gate	U12	1	TEXAS INSTRUMENTS	Narrow
	CD4001B			CD4001BM	SOIC-14N
				SOIC 14	

DRN	CHKD	APPD	CUST. REF.			BM-
						SHT. 4 of 4
						REV. 0

BY LAYER: TOP to BOTTOM				
ALL UNITS ARE IN MILLIMETERS				
FIGURE	FINISHED_SIZE	TOLERANCE_DRILL	PLATED	QTY
	0.5	+0.0/-0.0	PLATED	167
	0.7	+0.0/-0.0	PLATED	24
	0.8	+0.0/-0.0	PLATED	6
	1.0	+0.0/-0.0	PLATED	48
	1.0	+0.0/-0.0	PLATED	13
	1.2	+0.0/-0.0	PLATED	1
	1.2	+0.01/-0.01	PLATED	4
	2.0	+0.0/-0.0	PLATED	10
	2.0	+0.05/-0.05	PLATED	2
	2.7	+0.05/-0.05	PLATED	2
	2.8	+0.0/-0.0	PLATED	2

TOTAL HOLES: 279

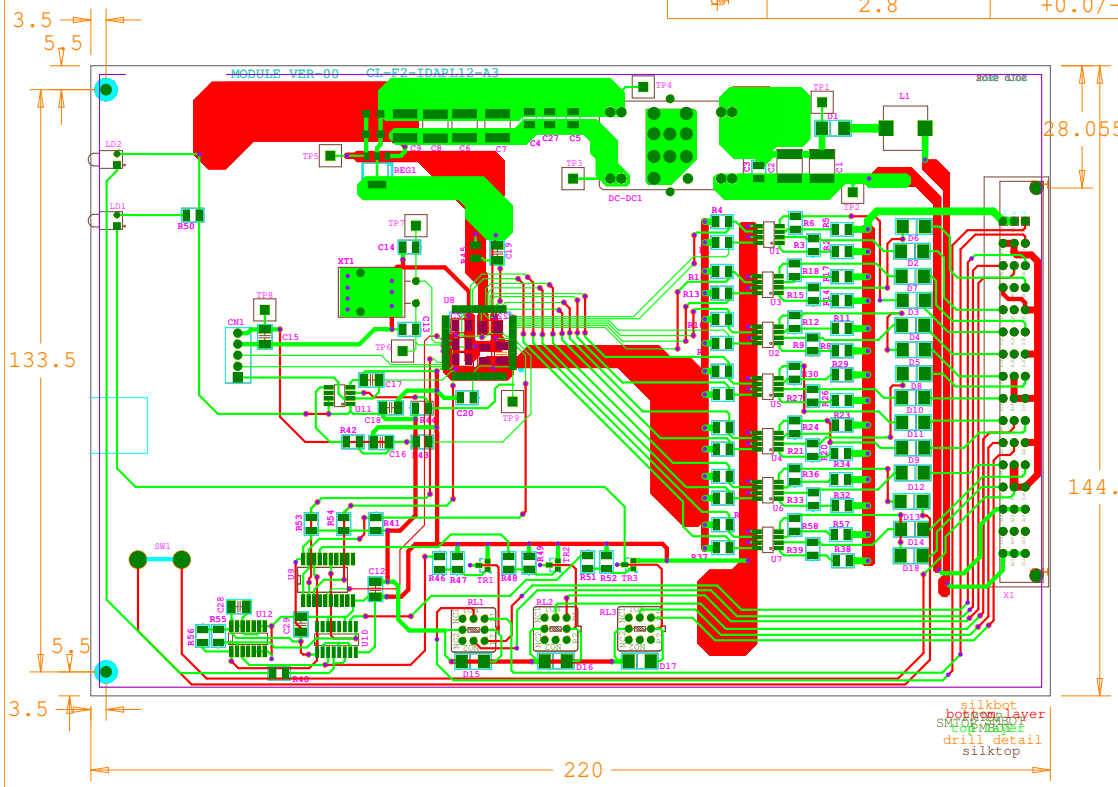


PCB FAB DETAILS:

1. 2 LAYER PCB
2. PCB MATERIAL:FR4 GLASS EPOXY
3. PCB THICKNESS: 1.6 MM
4. COPPER THICKNESS: 70 MICRONS
5. TINNING ENIG
6. MASKING GREEN
7. ALL DIMENSIONS ARE IN MM

Title:	Rev :
Description:	

BY LAYER: TOP to BOTTOM				
ALL UNITS ARE IN MILLIMETERS				
FIGURE	FINISHED_SIZE	TOLERANCE_DRILL	PLATED	QTY
⊕	0.5	+0.0/-0.0	PLATED	167
⊕	0.7	+0.0/-0.0	PLATED	24
⊕	0.8	+0.0/-0.0	PLATED	6
⊕	1.0	+0.0/-0.0	PLATED	48
⊕	1.0	+0.0/-0.0	PLATED	13
⊕	1.2	+0.0/-0.0	PLATED	1
⊕	1.2	+0.01/-0.01	PLATED	4
⊕	2.0	+0.0/-0.0	PLATED	10
◯	2.0	+0.05/-0.05	PLATED	2
◇	2.7	+0.05/-0.05	PLATED	2
⊕	2.8	+0.0/-0.0	PLATED	2
		TOTAL HOLES:		279



PCB FAB DETAILS:

1. 2 LAYER PCB
2. PCB MATERIAL:FR4 GLASS EPOXY
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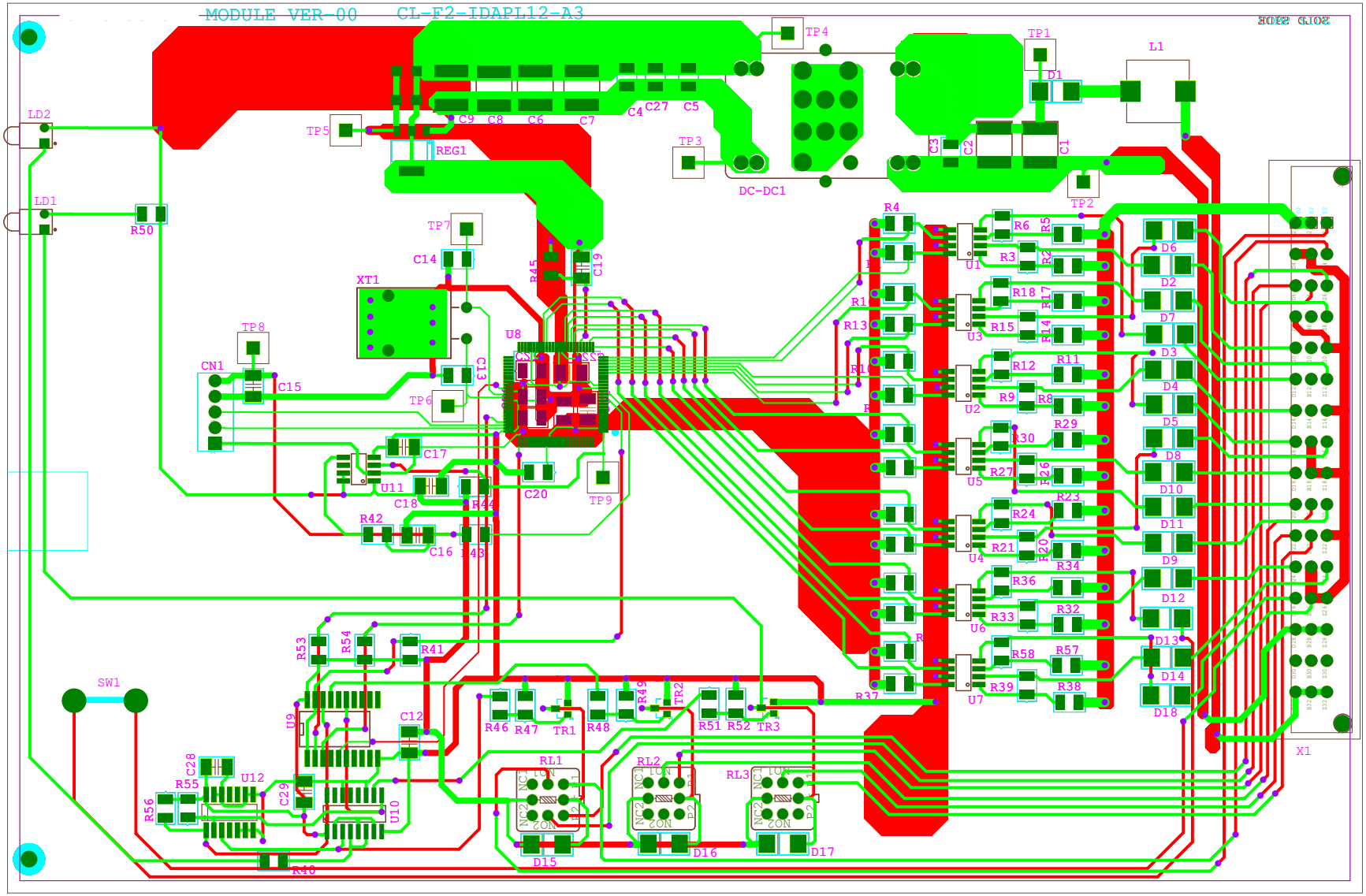
B A R C	
Title:	Rev : 1
Description:	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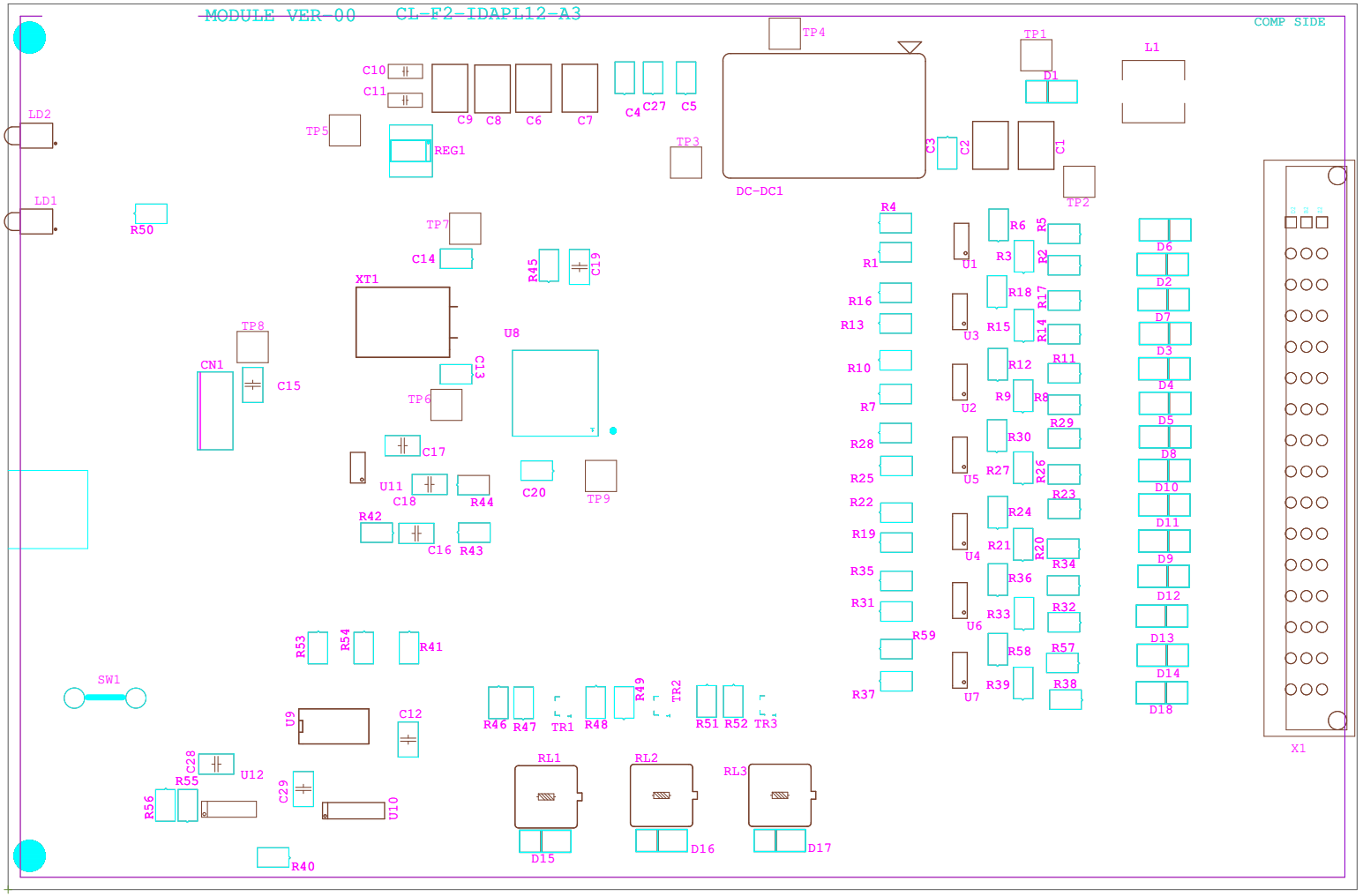
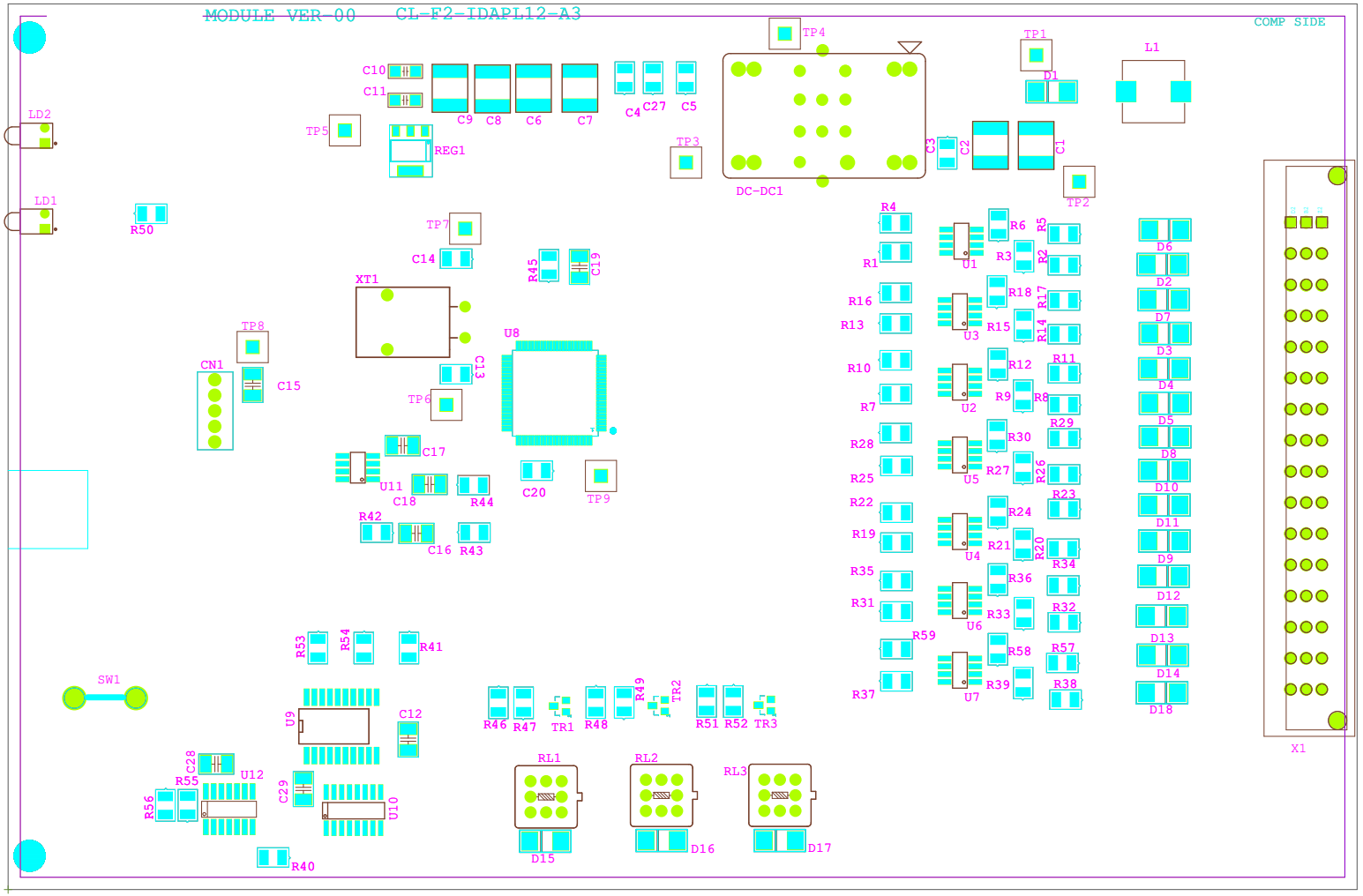
silkbot
bottomlayer
SMTOPSMBOT
toplayer

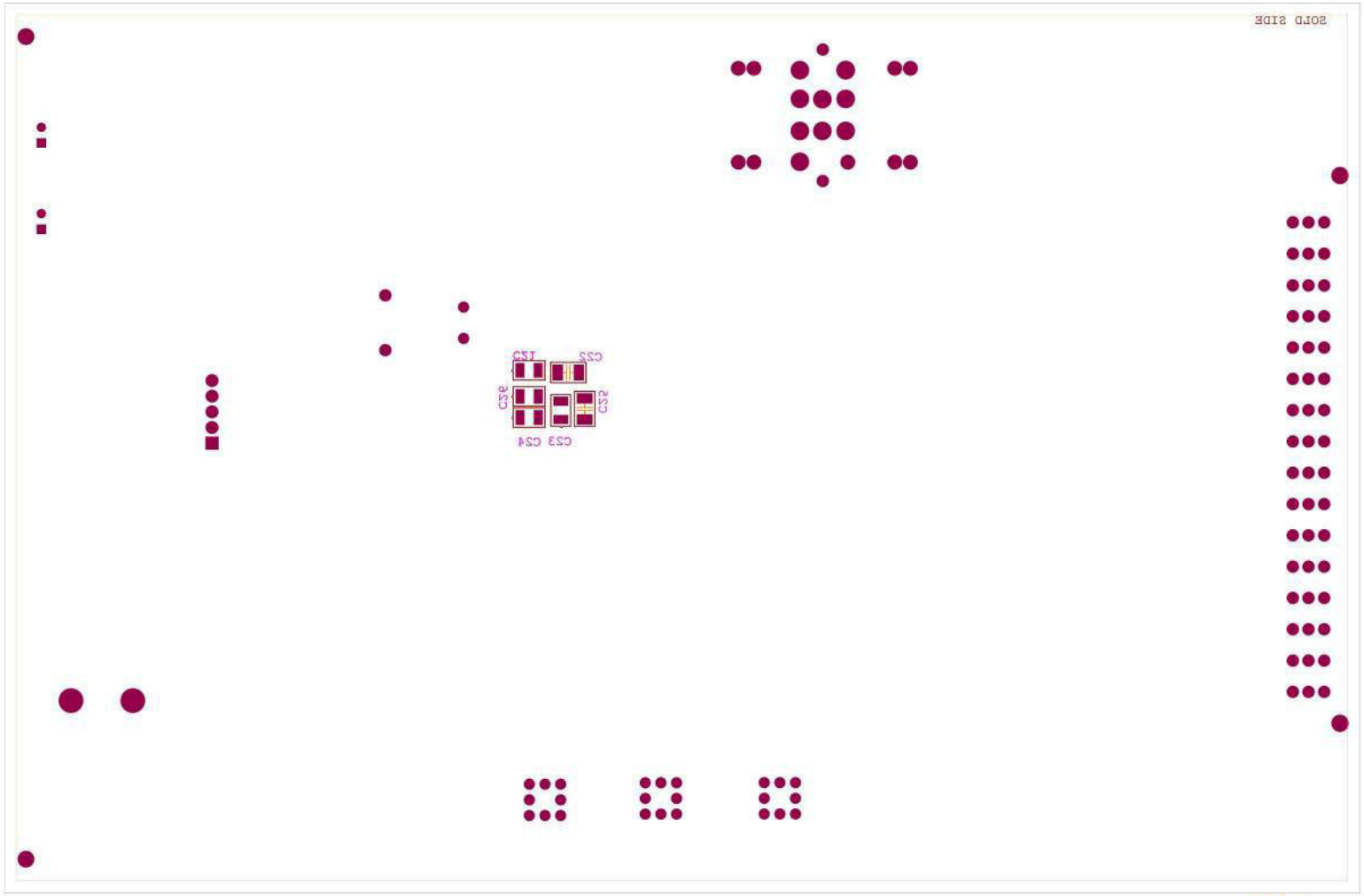

MODULE VER-00 CL-F2-IDAPL12-A3
COMP SIDE
LD2
LD1
R50
C10
C11
C9
C8
C6
C7
C4
C27
C5
TP5
REG1
TP4
TP3
DC-DC1
TP1
D1
L1
C3
C2
C1
TP2
TP7
C14
R45
C19
XT1
TP8
CN1
C15
C13
TP6
U8
C17
U11
C18
R44
C20
TP9
R42
C16
R43
R4
R1
R16
R13
R10
R7
R28
R25
R22
R19
R35
R31
R59
R37
U1
U3
U2
U5
U4
U6
U7
R6
R5
R3
R2
R18
R17
R15
R14
R12
R11
R9
R8
R30
R29
R27
R26
R24
R23
R21
R20
R36
R34
R33
R32
R58
R57
R39
R38
D6
D2
D7
D3
D4
D5
D8
D10
D11
D9
D12
D13
D14
D18
X1
R53
R54
R41
SW1
U9
C12
R46
R47
TR1
R48
R49
TR2
R51
R52
TR3
C28
R55
U12
R56
C29
U10
R40
RL1
RL2
RL3
D15
D16
D17

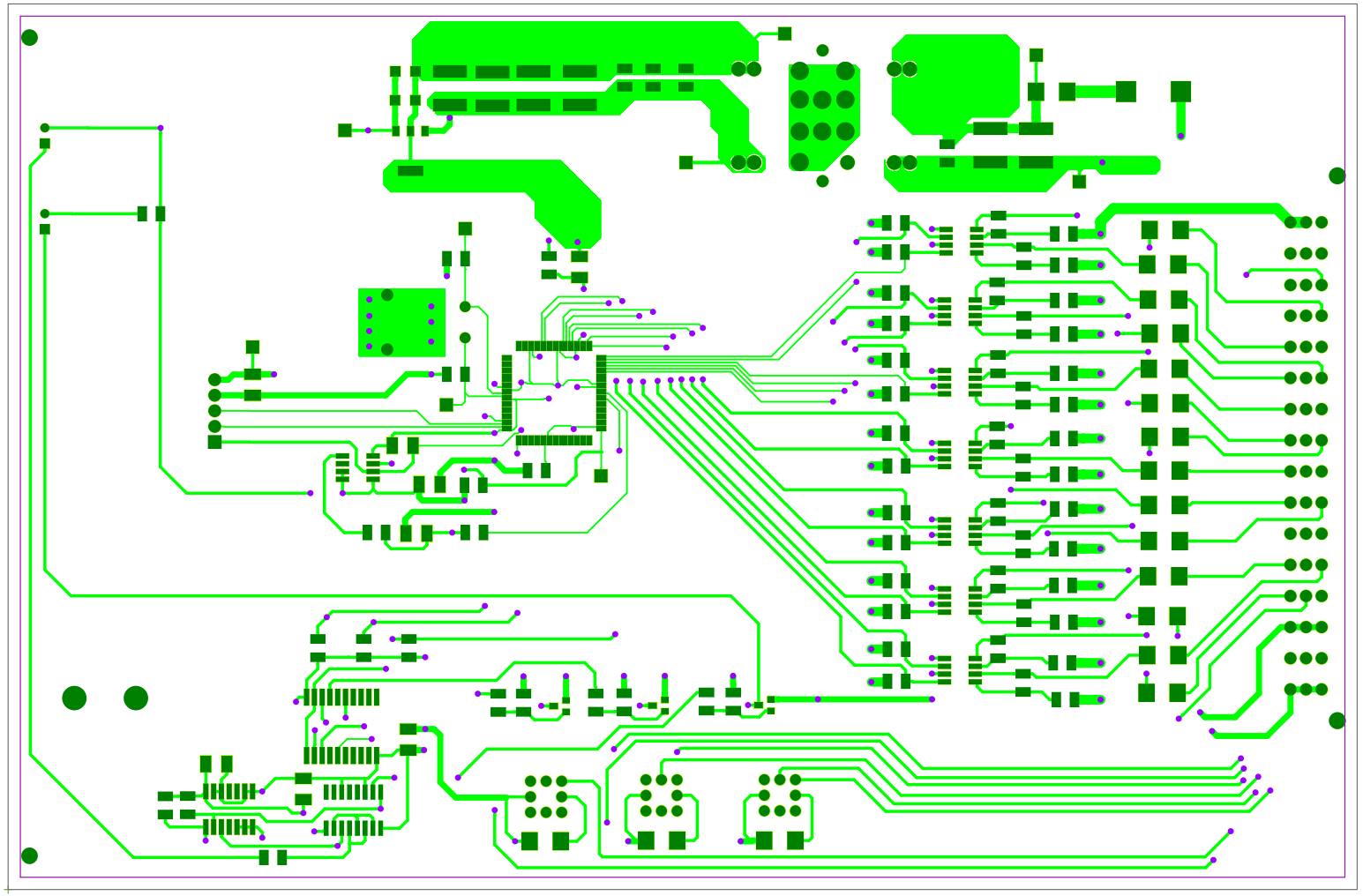
silktop


MODULE VER-00 CL-F2-IDAPL12-A3
COMP SIDE
LD2
LD1
R50
TP5
REG1
C10
C11
C9
C8
C6
C7
C4
C27
C5
TP4
DC-DC1
TP3
C3
C2
C1
TP1
D1
L1
TP2
TP7
C14
R45
C19
XT1
TP8
CN1
C15
C13
TP6
U8
C17
U11
C18
R44
C20
TP9
R42
C16
R43
R4
R1
R16
R13
R10
R7
R28
R25
R22
R19
R35
R31
R59
R37
U1
U3
U2
U5
U4
U6
U7
R6
R3
R5
R2
R18
R15
R17
R14
R12
R9
R11
R8
R29
R30
R27
R26
R23
R24
R21
R20
R34
R36
R33
R32
R58
R39
R57
R38
D6
D2
D7
D3
D4
D5
D8
D10
D11
D9
D12
D13
D14
D18
X1
SW1
R53
R54
R41
U9
C12
R46
R47
TR1
R48
R49
TR2
R51
R52
TR3
C28
R55
U12
R56
C29
U10
R40
RL1
RL2
RL3
D15
D16
D17

silktop

silkbot


SOLD SIDE
C51
C52
C53
C54
C55
C56
silkbot



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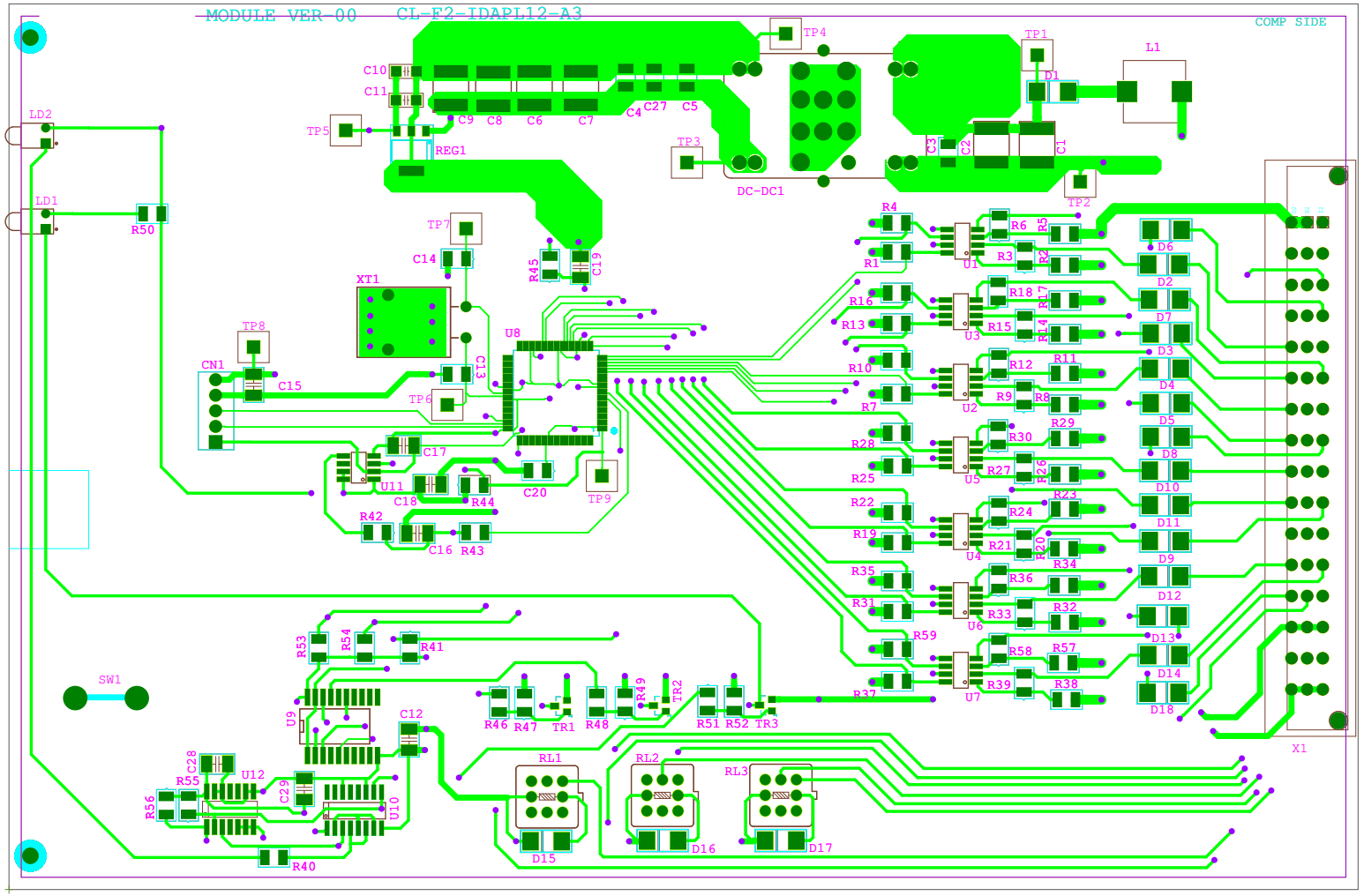
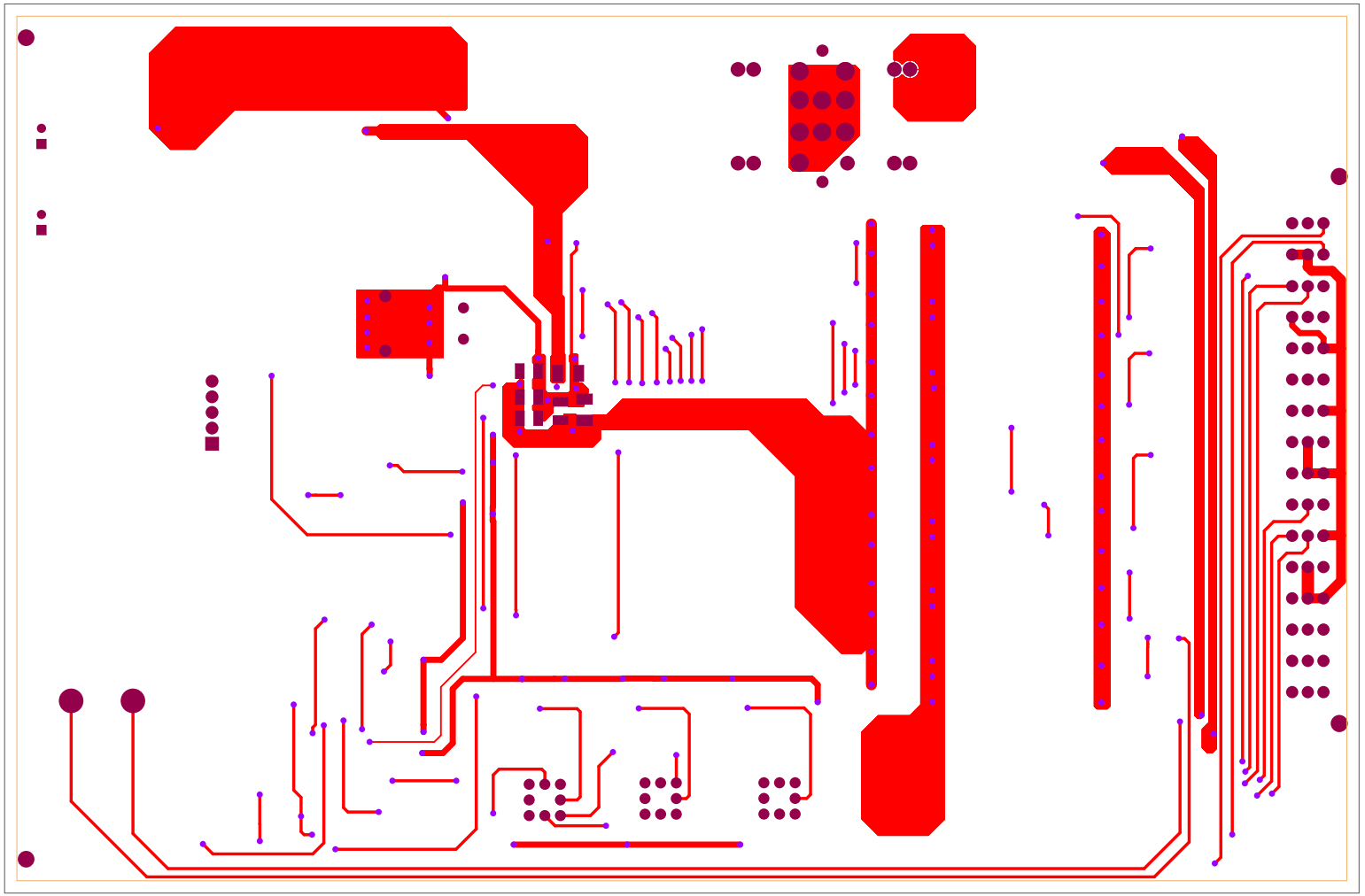
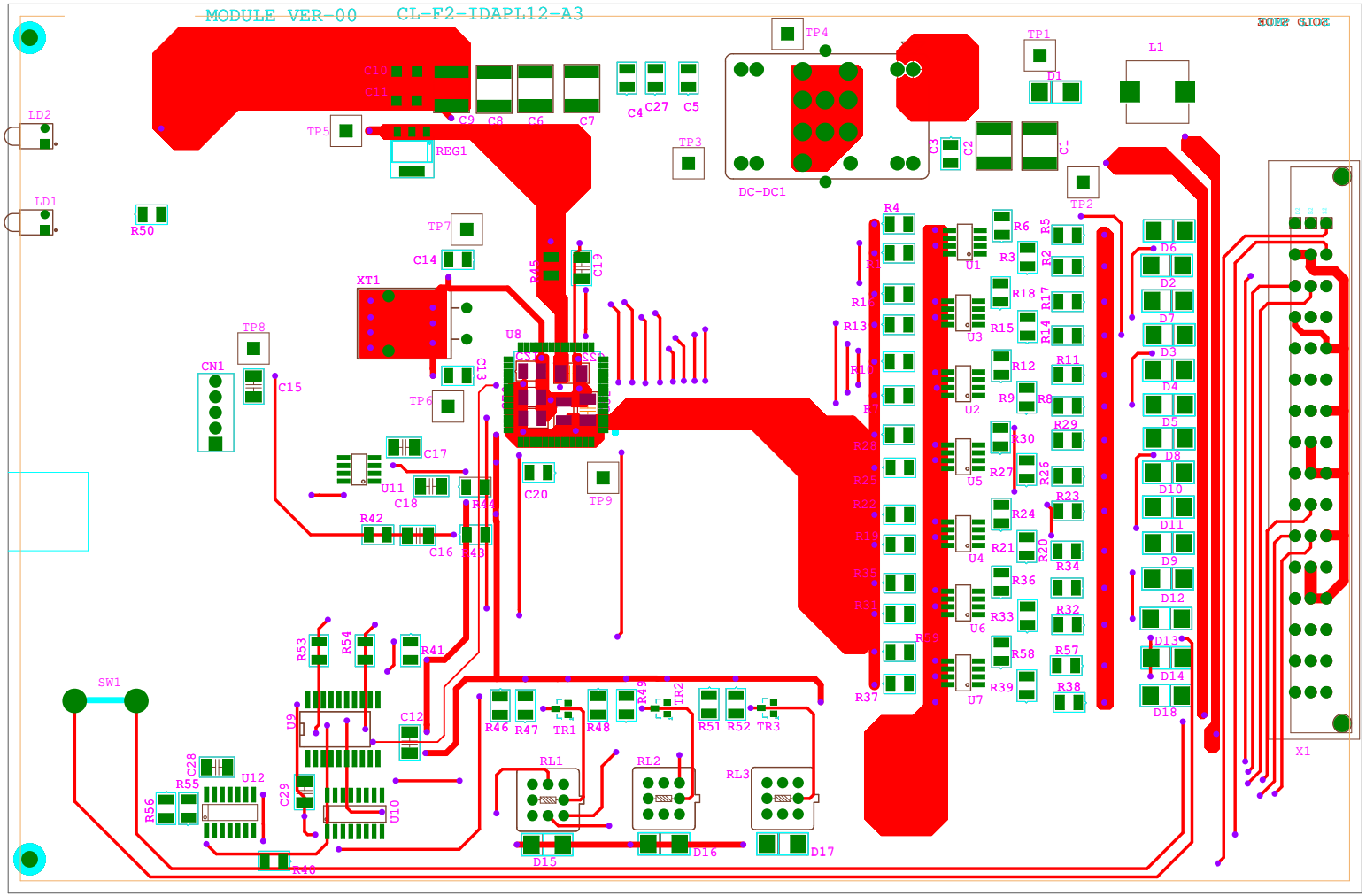


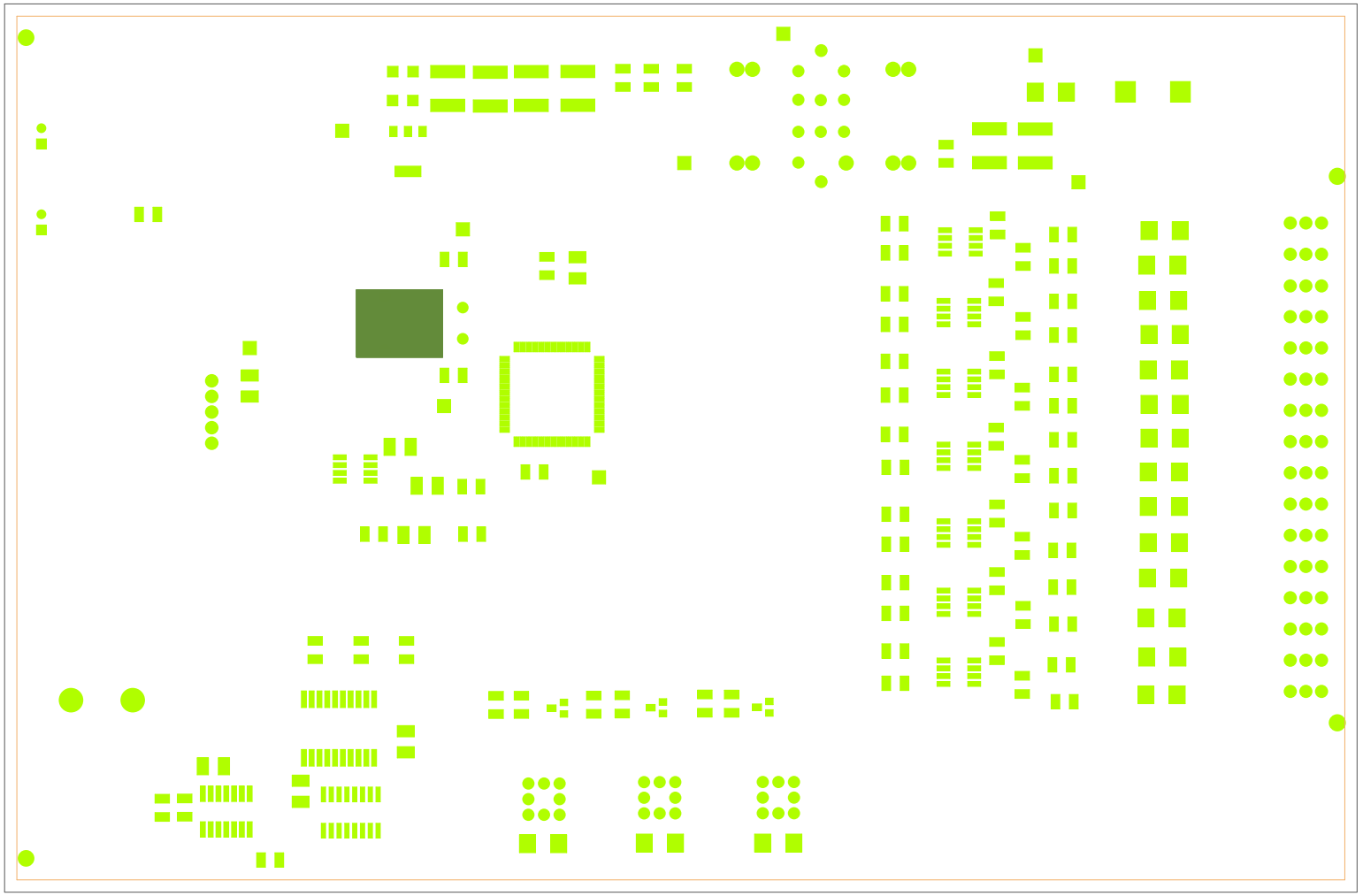
top layer

silktop

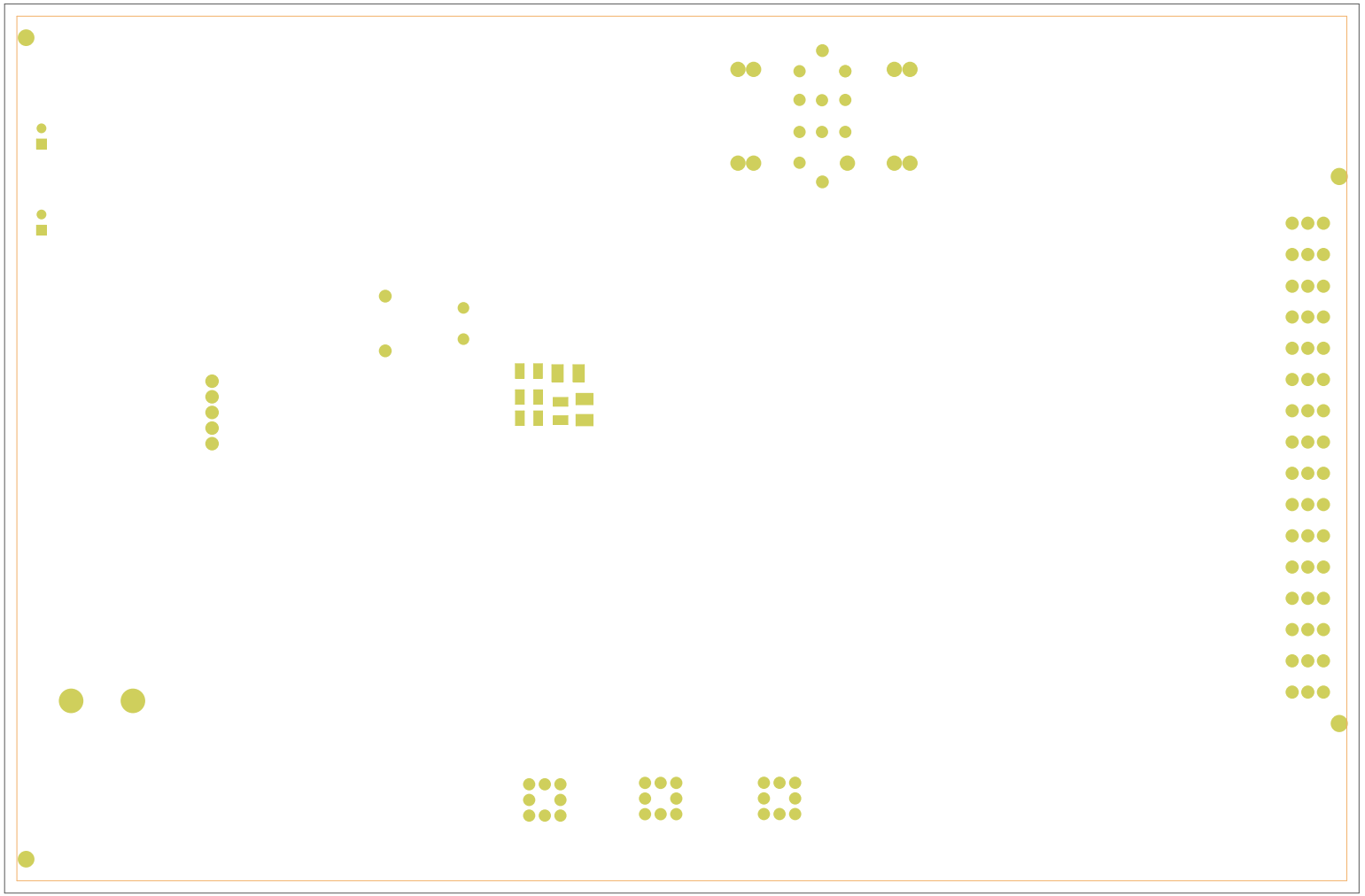


bottom layer

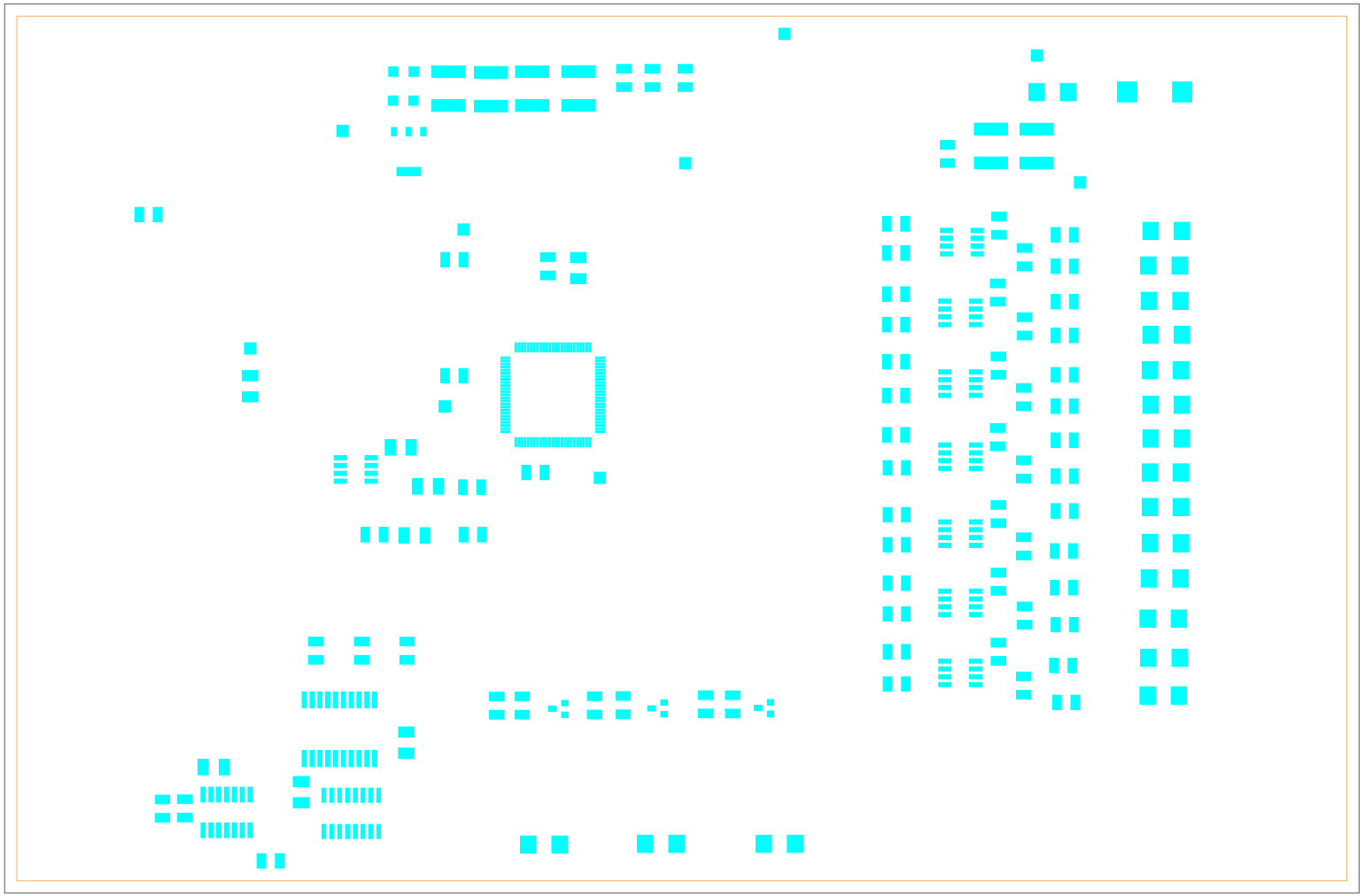

MODULE VER-00
CL-F2-IDAPL12-A3
silkbot
bottom layer



SMTOP

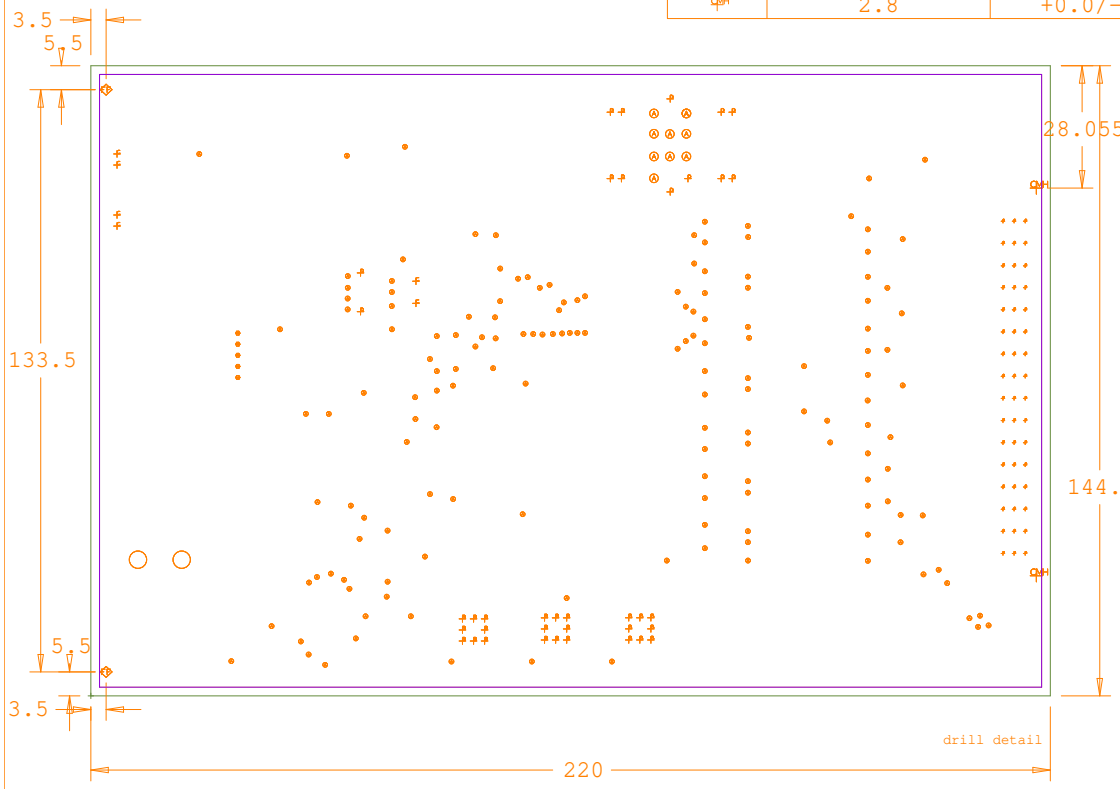


SMBOT



PMTOP

BY LAYER: TOP to BOTTOM				
ALL UNITS ARE IN MILLIMETERS				
FIGURE	FINISHED_SIZE	TOLERANCE_DRILL	PLATED	QTY
⊕	0.5	+0.0/-0.0	PLATED	167
⊕	0.7	+0.0/-0.0	PLATED	24
⊕	0.8	+0.0/-0.0	PLATED	6
⊕	1.0	+0.0/-0.0	PLATED	48
⊕	1.0	+0.0/-0.0	PLATED	13
⊕	1.2	+0.0/-0.0	PLATED	1
⊕	1.2	+0.01/-0.01	PLATED	4
⊕	2.0	+0.0/-0.0	PLATED	10
◯	2.0	+0.05/-0.05	PLATED	2
⊕	2.7	+0.05/-0.05	PLATED	2
⊕	2.8	+0.0/-0.0	PLATED	2
			TOTAL HOLES:	279



PCB FAB DETAILS:

1. 2 LAYER PCB
2. PCB MATERIAL:FR4 GLASS EPOXY
3. PCB THICKNESS: 1.6 MM
4. COPPER THICKNESS: 70 MICRONS
5. TINNING ENIG
6. MASKING GREEN
7. ALL DIMENSIONS ARE IN MM

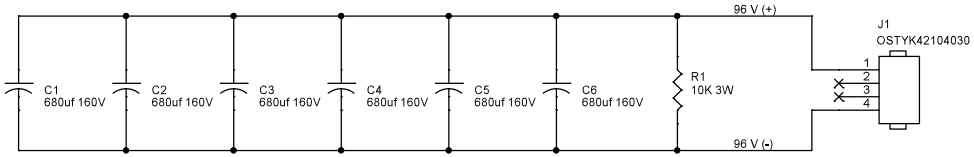
B A R C	
Title:	Rev : 1
Description:	

6. DC link capacitor plate

DRG.NO.

SHT. 1 OF 1

REV. 0



GENERAL ARRANGEMENT

BILL OF MATERIAL

TITLE DRG.No.

REFERENCE DRAWINGS

SCALE: PROJECTION

ALL DIMENSIONS ARE IN mm UNLESS STATED
OTHERWISE GENERAL TOLERANCE ANGLES ± 1/2°
FULL NOS. ±1 1 DEC.PLACE ±0.5
2 DEC.PLACE ±0.05 3 DEC.PLACE ±0.005

No.	LOC	REVISION DESCRIPTION	DRN DATE	APPD

ISSUE NO.	REV NO.	ISSUED FOR	PROJ.No.	ISSUE SHT.No.	DATE	APPD.
						Sd/-

TITLE CAPACITOR PLATE
ELECTRICAL SCHEMATIC

DRN	DRG. CHKD.	DES.	DES. CHKD.	APPD.
				PROJ. NO.

CUST DRG No.

SHT. 1 OF 1

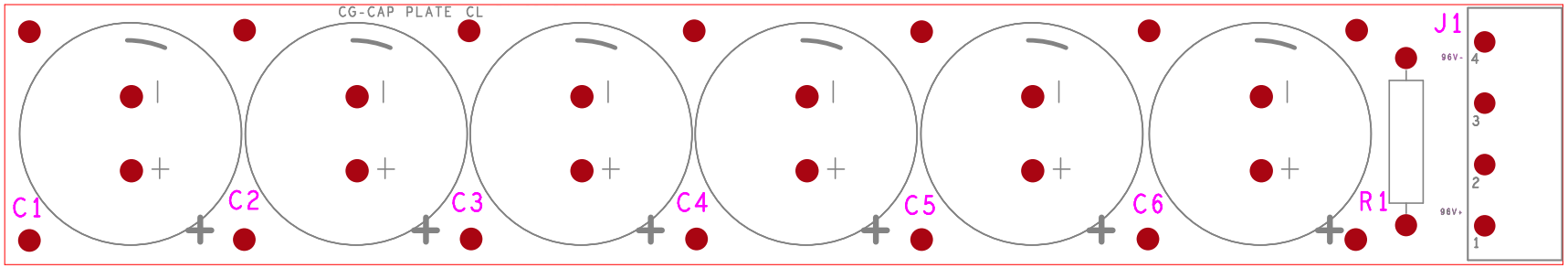
REV. 0

REV. NO.	DATE	REVISIONS / ISSUES	PREPARED	APPROVED
0		ISSUED FOR APPROVAL		

REFERENCE CL	**Capacitor Plate** BILL OF MATERIAL	
		PROJ. NO.
DATE		**BM-**
PREPD		
CHKD		SHT. 1 OF 2
APPD		REV. 0

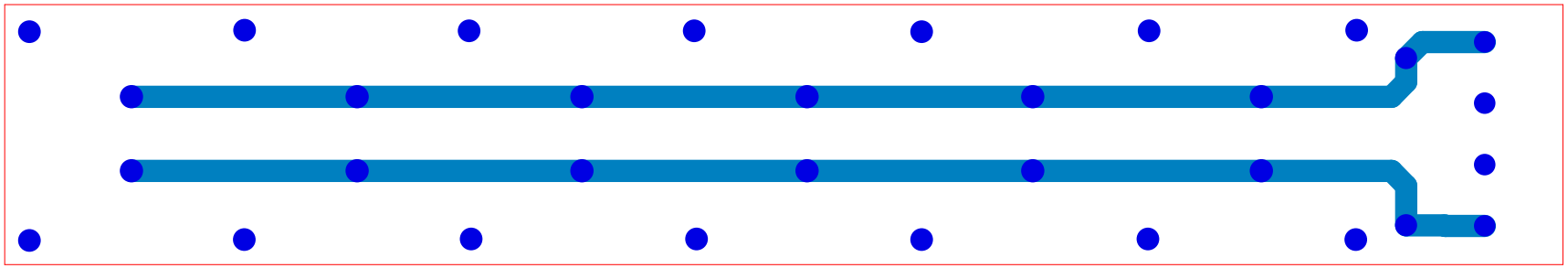
ITEM NO.	DESCRIPTION	IDENTITY	QTY.	MATL. SPEC./ DRG. NO./ MAKE&TYPE	REMARKS	PROC. REF.
1	PRINTED CIRCUIT BOARD	PCB1	1			
2	capacitor 680uf/160V, 20 %	C1,C2,C3,C4,C5,C6	6	EPCOS/TDK B43252C1687M000		
3	Terminal block	J1	1	OSTYK42104030 OSTYK42104030		
4	Resistor 10K 3W	R1	1	CPF310K000FKE14 CPF310K000FKE14		

DRN	CHKD	APPD	CUST. REF.	BM-
				SHT. 2 OF 2
				REV. 0



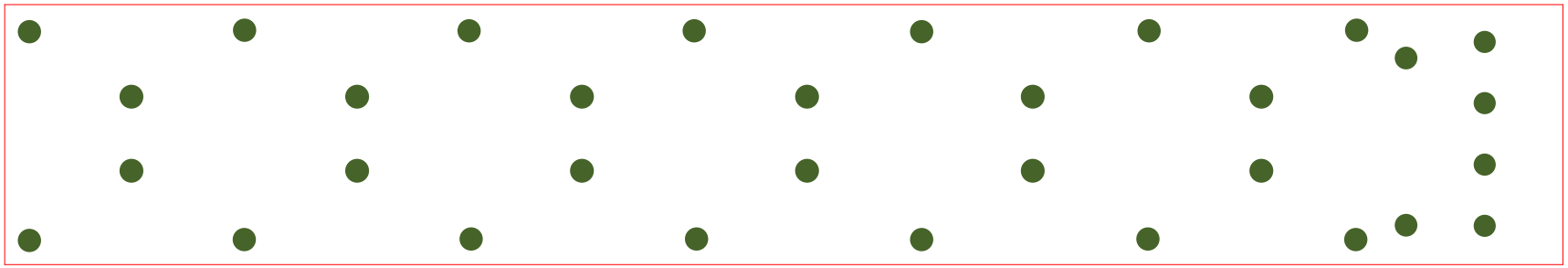
CAP PLATE,210 x35 MM,03.08.2021

SILKSCREEN TOP



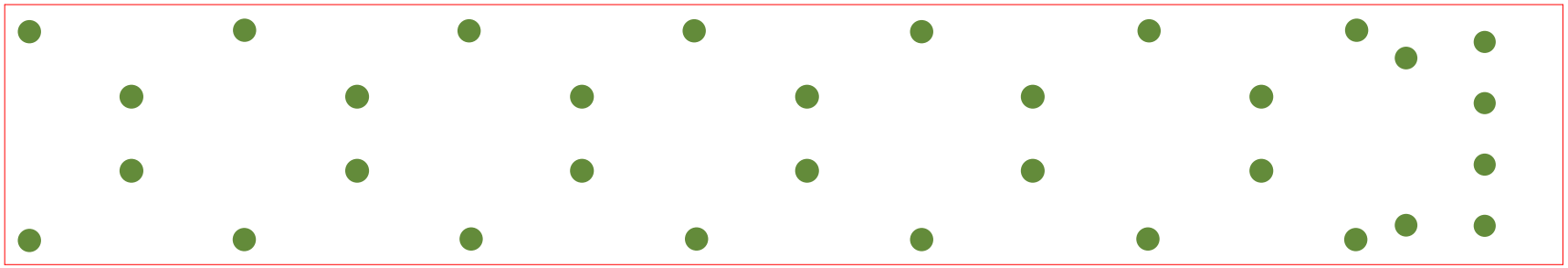
CAP PLATE,210 x35 MM,03.08.2021

L2-BOTTOM



CAP PLATE,210 x35 MM,03.08.2021

SOLDER MASK TOP

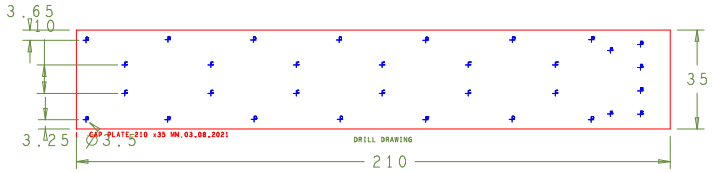


CAP PLATE,210 x35 MM,03.08.2021

SOLDER MASK BOTTOM

B A R C	
TITLE: CAP PLATE	REV:
DESCRIPTION:	

PCB FAB DETAILS:
1. 2 LAYER PCB
2. PCB MATERIAL : FR4 GLASS EPOXY
3. PCB THICKNESS : 1.6 MM
4. COPPER THICKNESS : 70 MICRONS
5. TINNING ENIG
6. MASKING GREEN
7. ALL DIMENSIONS IN MM



DRILL CHART: TOP to BOTTOM			
ALL UNITS ARE IN MILLIMETERS			
FIGURE	FINISHED SIZE	PLATED	QTY
+	1.2	PLATED	2
+	1.9	PLATED	4
+	2.0	PLATED	12
+	3.0	PLATED	14