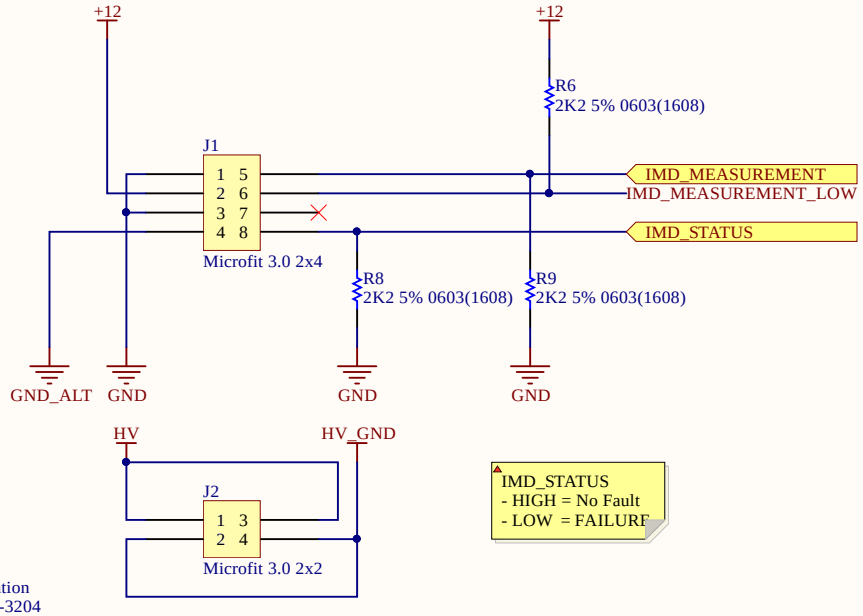
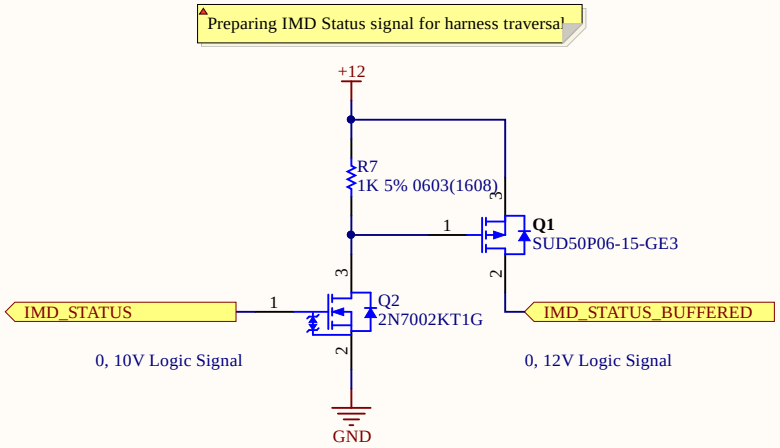


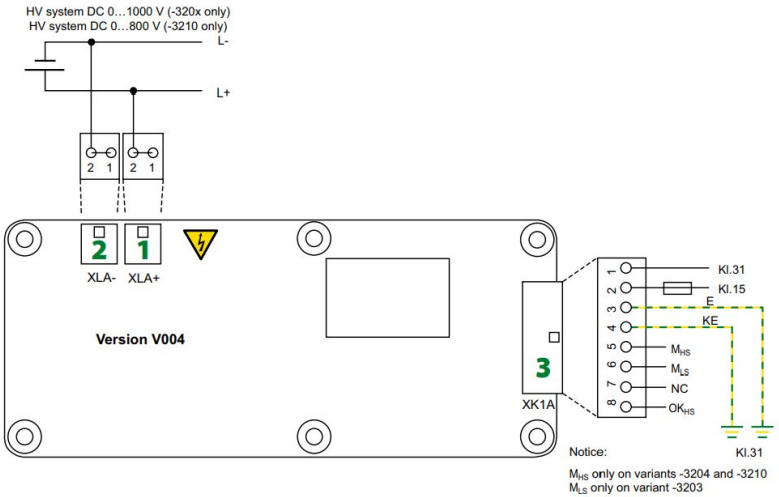




Bender IMD Board Information

| | |
|---|---|
| Part Number: | IR155-3204 |
| Serial Number: | 1312000065 |
| Mat. Number: | B91068139V4 |
| Software Version: | D331 V2.01 |

https://www.bender.de/fileadmin/content/Products/d/e/IR155-32xx-V004_D00115_D_XXEN.pdf

## Wiring diagrams




**1 - Connector XLA+**

| | | |
|---|---|---|
| Pin 1+2 | L+ | Line Voltage |

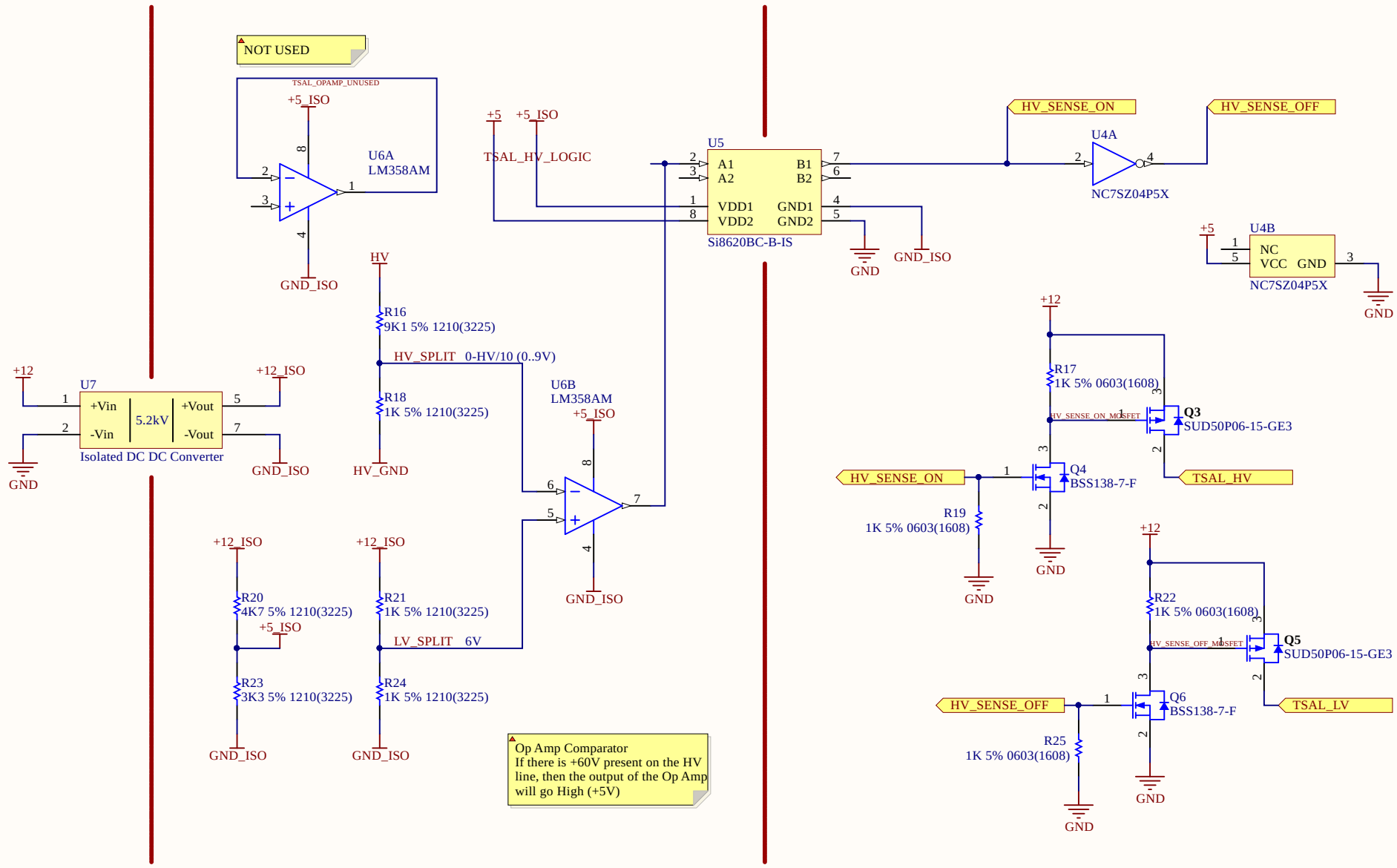
**2 - Connector XLA-**

| | | |
|---|---|---|
| Pin 1+2 | L- | Line Voltage |

**3 - Connector XK1A**

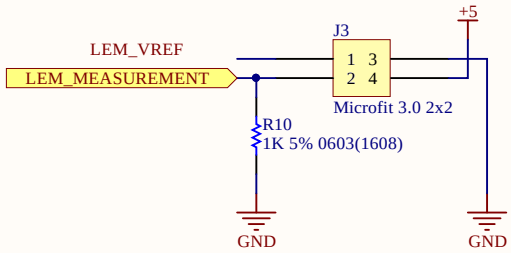
| | | |
|---|---|---|
| Pin 1 | Kl. 31 | Chassis ground/ electronic ground |
| Pin 2 | Kl. 15 | Supply voltage |
| Pin 3 | Kl. 31 | Chassis ground |
| Pin 4 | Kl. 31 | Chassis ground (separate line) |
| Pin 5 | $M_{HS}$ | Data Out, PWM (high side) |
| Pin 6 | $M_{LS}$ | Data Out, PWM (low side) |
| Pin 7 | n.c. | |
| Pin 8 | $OK_{HS}$ | Status Output (high side) |

| | | | |
|---|---|---|---|
| Title | *QUTMS - HVBoard - IMD* | | |
| Size: A4 | Number:2 | Revision:* | |
| Date: 16/05/2019 | Time: 3:16:42 PM | Sheet2 of 5 | |
| File: R:\Users\Jonn\Documents\git\qutms\QUTMS_HVBoard\QUTMS_HVBoard\IMD.SchDoc | | | |



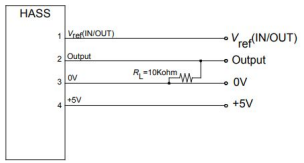

https://www.digikey.com.au/product-detail/en/recom-power/RP-1212S/945-1254-ND/2256434

| | | | |
|---|---|---|---|
| Title | *QUTMS - HVBoard - TSAL* | | |
| Size: A4 | Number:3 | Revision:* | |
| Date: 16/05/2019 | Time: 3:16:42 PM | Sheet3 of 5 | |
| File: R:\Users\Jonn\Documents\git\qutms\QUTMS_HVBoard\QUTMS_HVBoard\TSAL.SchDoc | | | |

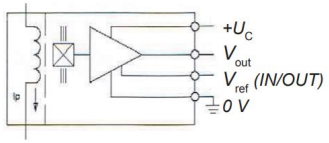



LEM Sensor HASS-200S https://www.lem.com/en/hass-200s
LEM Sensor HASS-400S https://www.lem.com/en/hass-400s
Datasheet https://www.lem.com/sites/default/files/products_datasheets/hass_50_600-s.pdf

## Required connection circuit




## Operation principle



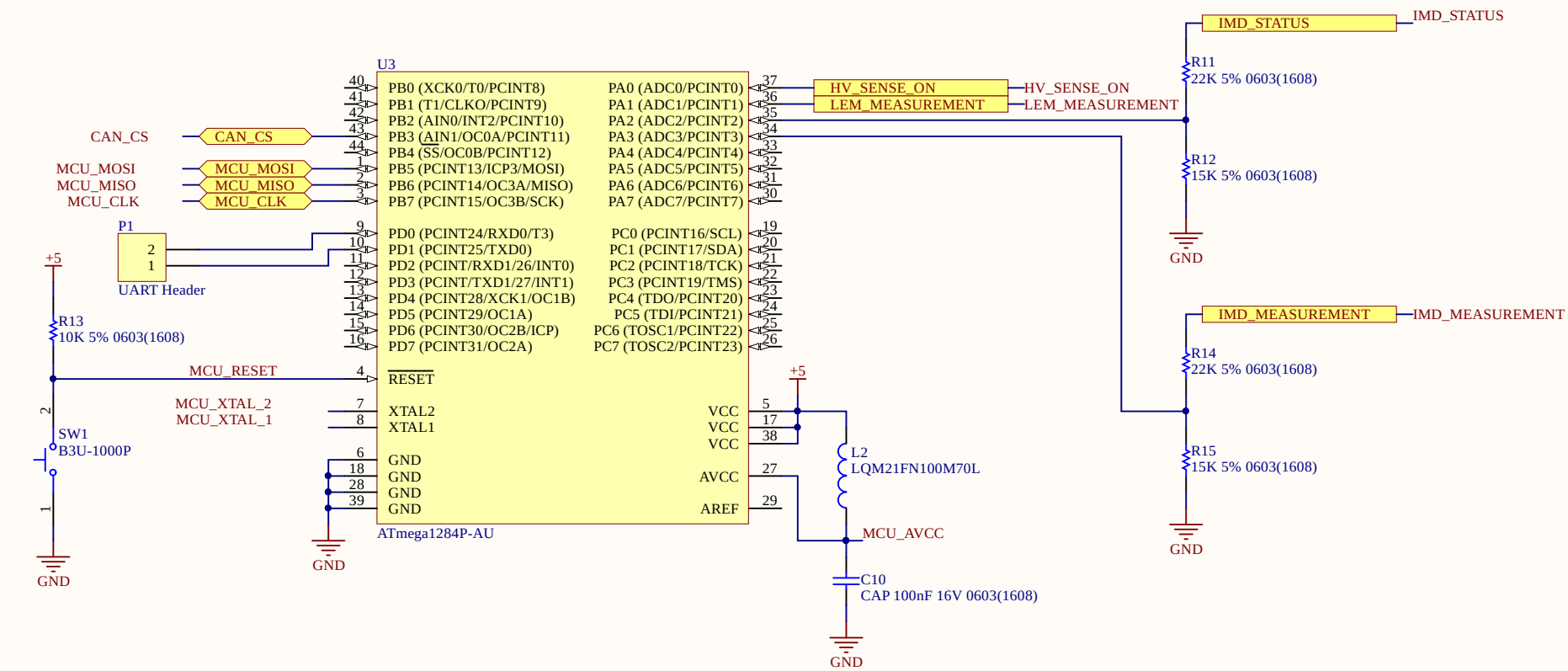

## Mechanical characteristics

| | |
|---|---|
| General tolerance | ±0.5 mm |
| Aperture for primary conductor | 20.4 × 10.4 × 0.5 mm |
| Transducer fastening | M4 |
| Recommended fastening torque | <1.5 N·m |
| Connection of secondary | Molex 5045-04A |

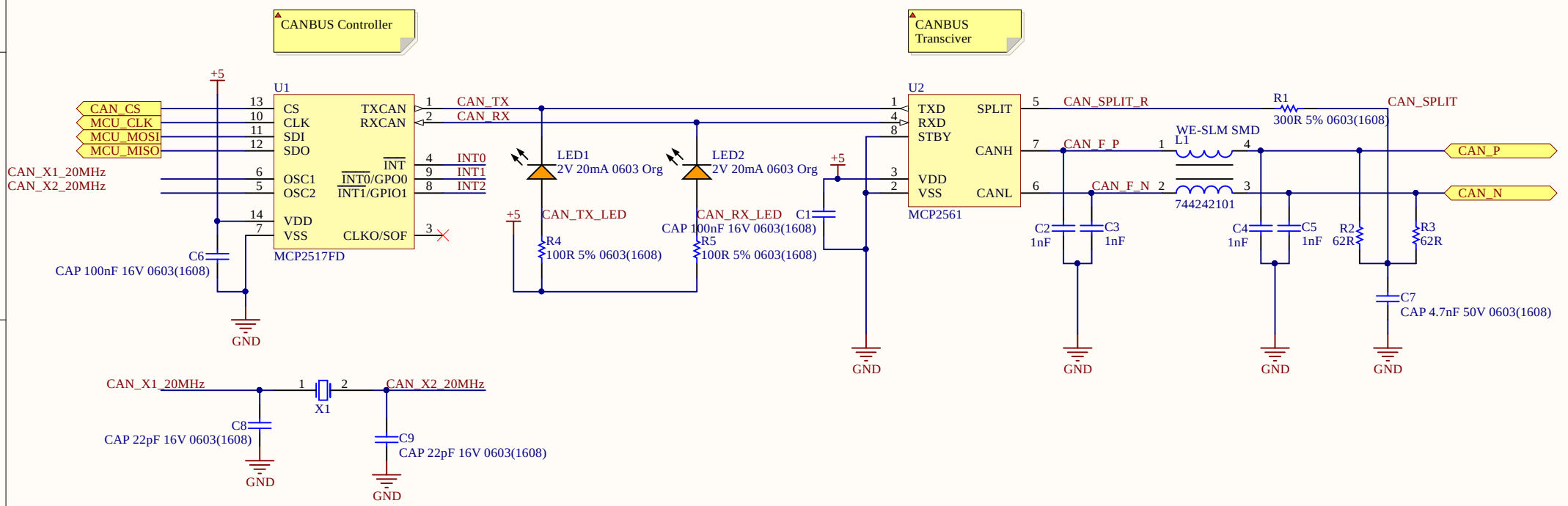
## Remarks

- $I_S$ is positive when $I_P$ flows in the direction of the arrow.
- Temperature of the primary conductor should not exceed 120 °C.
- This is a standard model. For different versions (supply voltages, turns ratios, unidirectional measurements...), please contact us.
- Installation of the transducer must be done unless otherwise specified on the datasheet, according to LEM Transducer Generic Mounting Rules. Please refer to LEM document N°ANE120504 available on our Web site: **Products/Product Documentation.**

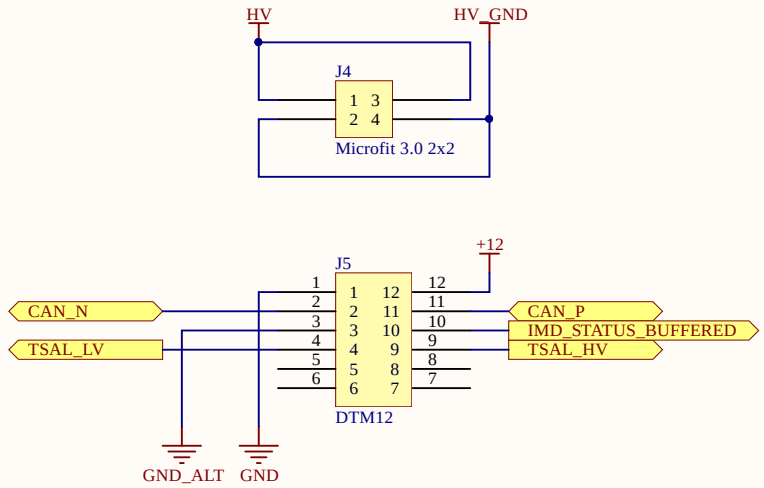
| | | | |
|---|---|---|---|
| Title | *QUTMS - HVBoard - LEM* | | * * * * * |
| Size: A4 | Number:4 | Revision:* | |
| Date: 16/05/2019 | Time: 3:16:42 PM | Sheet4 of 5 | |
| File: R:\Users\Jonn\Documents\git\qutms\QUTMS_HVBoard\QUTMS_HVBoard\LEM.SchDoc | | | |



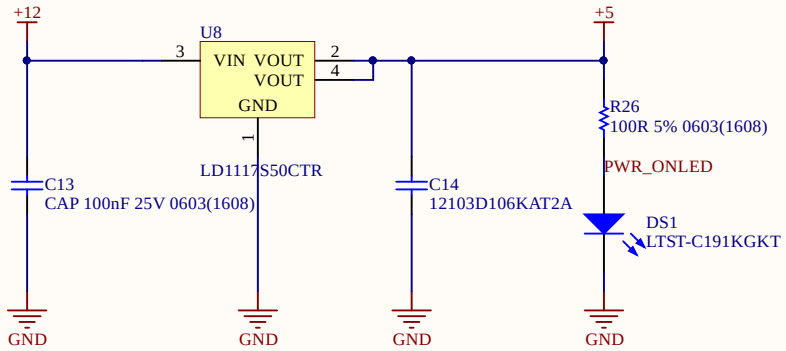

| | | | |
|---|---|---|---|
| Title | ***QUTMS - HVBoard - MCU*** | | |
| Size: A4 | Number: 5 | Revision: * | |
| Date: 16/05/2019 | Time: 3:16:42 PM | Sheet 5 of 5 | |
| File: R:\Users\Jonn\Documents\git\qutms\QUTMS_HVBoard\QUTMS_HVBoard\MCU.SchDoc | | | |



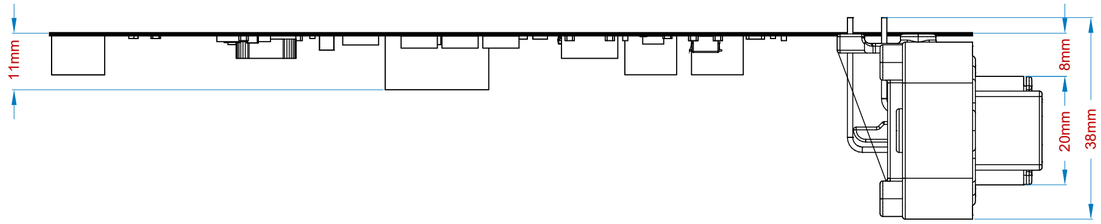

| | | | |
|---|---|---|---|
| Title | **QUTMS - HVBoard - CANBUS** | | QUT Motorsport * * * * |
| Size: A4 | Number:* | Revision:* | |
| Date: 16/05/2019 | Time: 3:16:43 PM | Sheet* of * | |
| File: R:\Users\Jonn\Documents\git\qutms\QUTMS_HVBoard\QUTMS_HVBoard\CAN.SchDoc | | | |

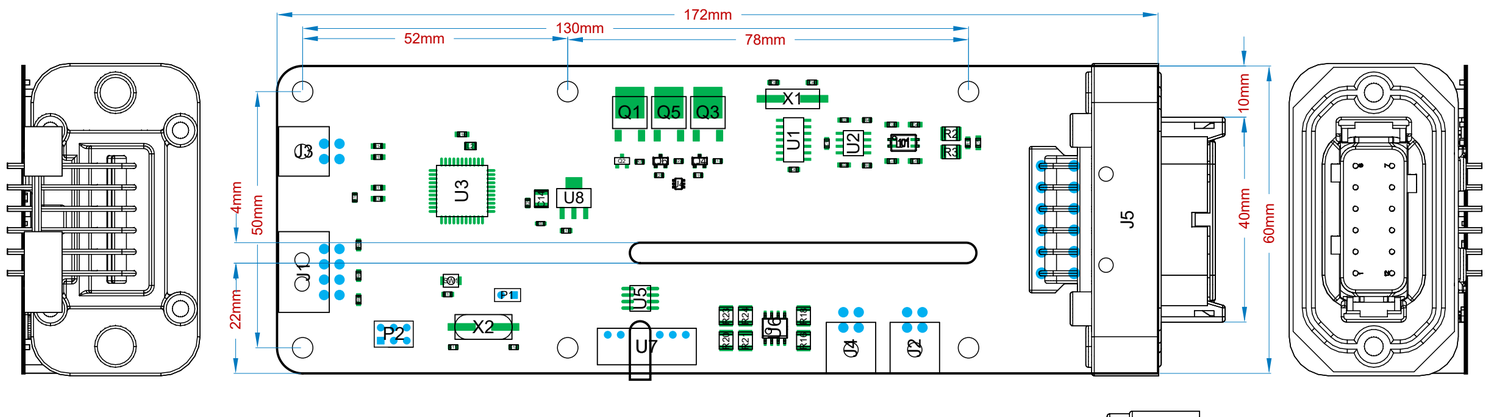


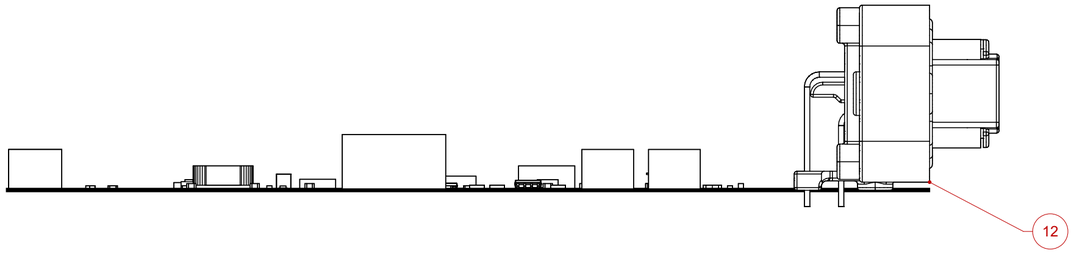

| | | | |
|---|---|---|---|
| Title | ***QUTMS - HVBoard - Offboard*** | | |
| Size: A4 | Number:* | Revision:* | |
| Date: 16/05/2019 | Time: 3:16:43 PM | Sheet* of * | |
| File: R:\Users\Jonn\Documents\git\qutms\QUTMS_HVBoard\QUTMS_HVBoard\Offboard.SchDoc | | | |

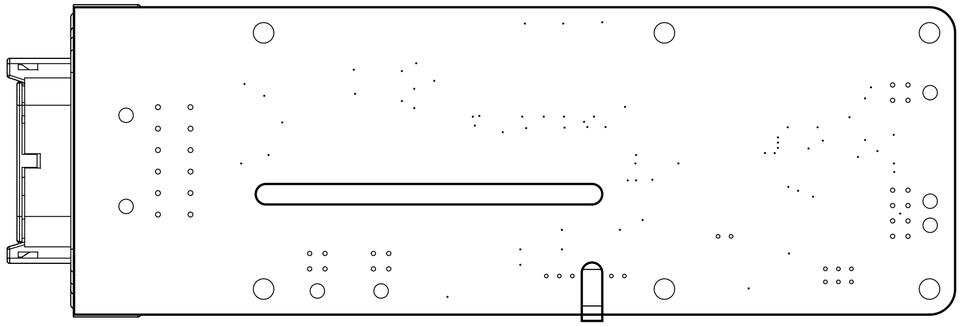



| | | | |
|---|---|---|---|
| Title | | | |
| Size A4 | Number | | Revision |
| Date: 16/05/2019 | | Sheet | of |
| File: R:\Users\..\Power.SchDoc | | Drawn By: | |



| | | | | | |
|---|---|---|---|---|---|
| | | UNLESS OTHERWISE SPECIFIED: | | NAME | DATE |
| | | DIMENSIONS ARE IN INCHES<br>TOLERANCES:<br>FRACTIONAL±<br>ANGULAR: MACH± BEND ±<br>TWO PLACE DECIMAL ±<br>THREE PLACE DECIMAL ± | DRAWN | | 16/05/2019 |
| | | | CHECKED | | |
| | | | ENG APPR. | | |
| | | | MFG APPR. | | |
| | | INTERPRET GEOMETRIC TOLERANCING PER: | Q.A. | | |
| | | MATERIAL | COMMENTS: | | |
| NEXT ASSY | USED ON | FINISH | | | |
| APPLICATION | | DO NOT SCALE DRAWING | | | |

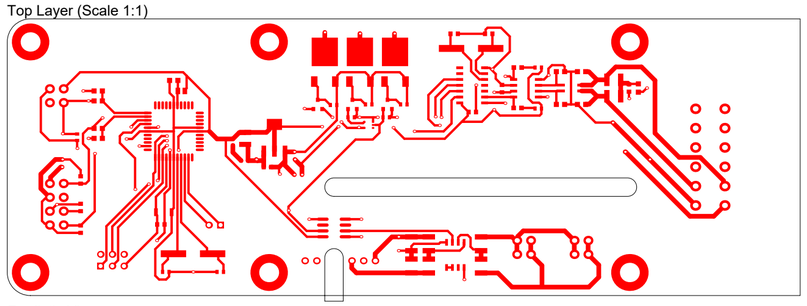
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF . ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF IS

PROPRIETARY AND CONFIDENTIAL

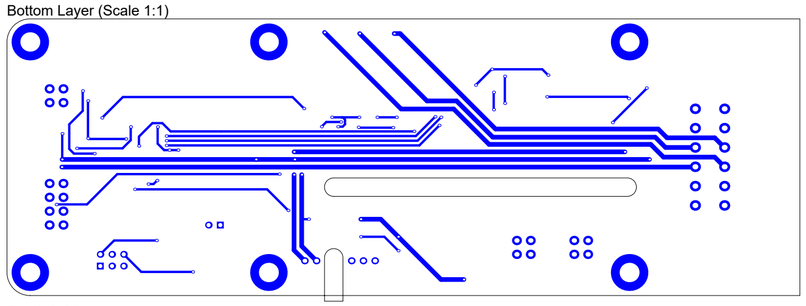
TITLE

| SIZE | DWG. NO. | |
|---|---|---|
| SCALE: 1:1 | WEIGHT: | SHEET 1 OF 3 |

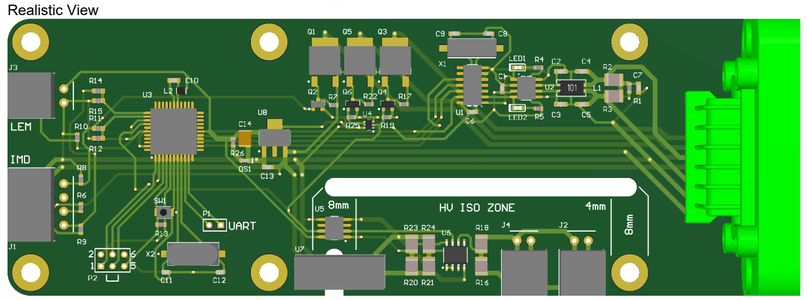
Top Layer (Scale 1:1)



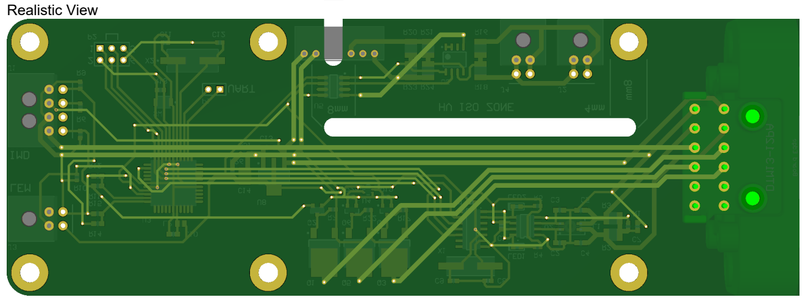
Bottom Layer (Scale 1:1)



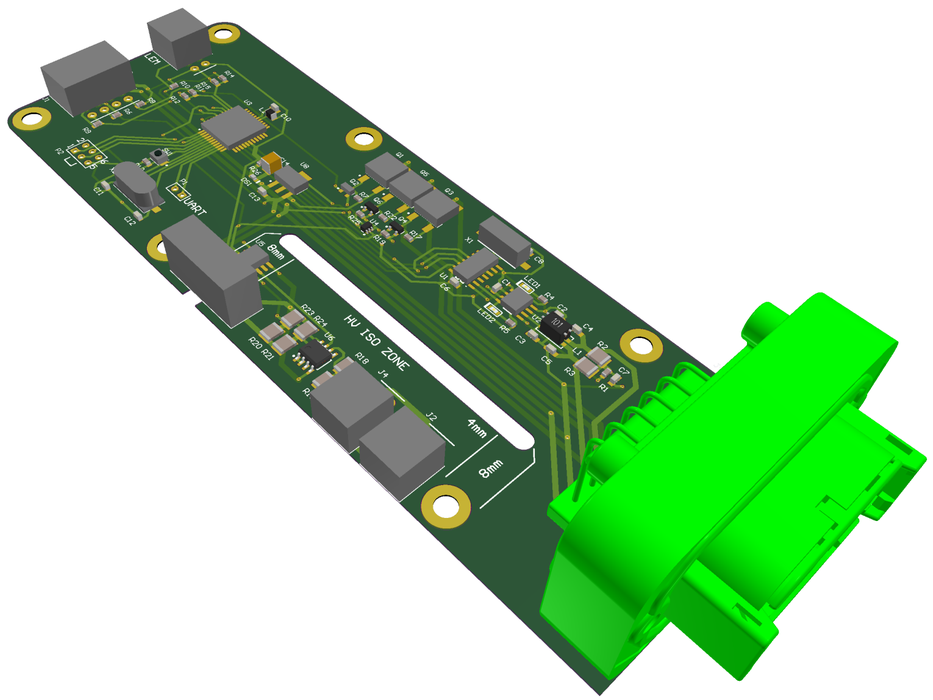
Realistic View




Realistic View



Realistic View




| | | | | | |
|---|---|---|---|---|---|
| | | UNLESS OTHERWISE SPECIFIED: | | NAME | DATE |
| | | DIMENSIONS ARE IN INCHES<br>TOLERANCES:<br>FRACTIONAL±<br>ANGULAR: MACH± BEND ±<br>TWO PLACE DECIMAL ±<br>THREE PLACE DECIMAL ± | DRAWN | | 16/05/2019 |
| | | | CHECKED | | |
| | | | ENG APPR. | | |
| | | | MFG APPR. | | |
| | | INTERPRET GEOMETRIC TOLERANCING PER: | Q.A. | | |
| | | MATERIAL | COMMENTS: | | |
| NEXT ASSY | USED ON | FINISH | | | |
| APPLICATION | | DO NOT SCALE DRAWING | | | |

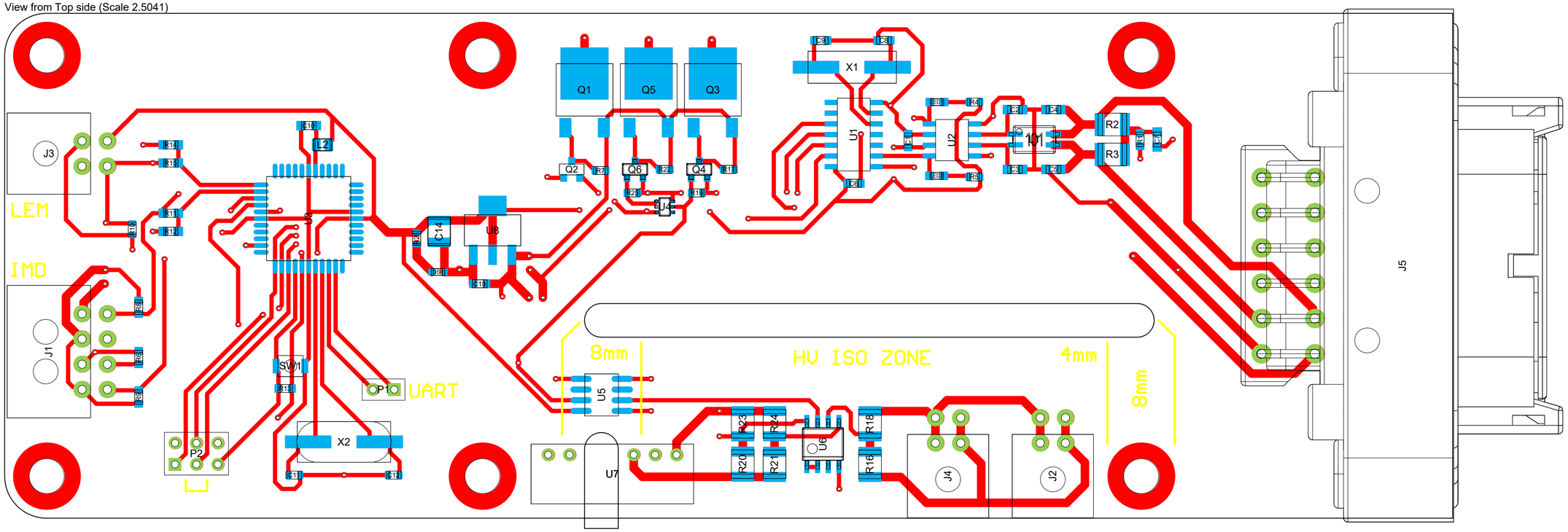
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF . ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF IS

PROPRIETARY AND CONFIDENTIAL

TITLE

| SIZE | DWG. NO. | |
|---|---|---|
| SCALE: 1:1 | WEIGHT: | SHEET 2 OF 3 |

View from Top side (Scale 2.5041)




Bill Of Materials

| Line # | Designator | Comment | Quantity |
|---|---|---|---|
| 1 | C1, C6 | CAP 100nF 16V 0603(1608) | 2 |
| 2 | C2, C3, C4, C5 | 1nF | 4 |
| 3 | C7 | CAP 4.7nF 50V 0603(1608) | 1 |
| 4 | C8, C9 | CAP 22pF 16V 0603 (1608) | 2 |
| 5 | C10 | CAP 100nF 16V 0603(1608) | 1 |
| 6 | C11, C12 | CAP 22pF 16V 0603 (1608) | 2 |
| 7 | C13 | CAP 100nF 25V 0603(1608) | 1 |
| 8 | C14 | 12103D106KAT2A | 1 |
| 9 | DS1 | LTST-C191KGKT | 1 |
| 10 | J1 | Microfit 3.0 2x4 | 1 |
| 11 | J2, J3, J4 | Microfit 3.0 2x2 | 3 |
| 12 | J5 | DTM12 | 1 |
| 13 | L1 | 744242101 | 1 |
| 14 | L2 | LQM21FN100M70L | 1 |
| 15 | LED1, LED2 | 2V 20mA 0603 Org | 2 |
| 16 | P1 | UART Header | 1 |
| 17 | P2 | Header 3X2 | 1 |
| 18 | Q1, Q3, Q5 | SUD50P06-15-GE3 | 3 |
| 19 | Q2 | 2N7002KT1G | 1 |

Bill Of Materials

| Line # | Designator | Comment | Quantity |
|---|---|---|---|
| 20 | Q4, Q6 | BSS138-7-F | 2 |
| 21 | R1 | 300R 5% 0603 (1608) | 1 |
| 22 | R2, R3 | 62R | 2 |
| 23 | R4, R5, R26 | 100R 5% 0603 (1608) | 3 |
| 24 | R6, R8, R9 | 2K2 5% 0603(1608) | 3 |
| 25 | R7, R10, R17, R19, R22, R25 | 1K 5% 0603(1608) | 6 |
| 26 | R11, R14 | 22K 5% 0603(1608) | 2 |
| 27 | R12, R15 | 15K 5% 0603(1608) | 2 |
| 28 | R13 | 10K 5% 0603(1608) | 1 |
| 29 | R16 | 9K1 5% 1210(3225) | 1 |
| 30 | R18, R21, R24 | 1K 5% 1210(3225) | 3 |
| 31 | R20 | 4K7 5% 1210(3225) | 1 |
| 32 | R23 | 3K3 5% 1210(3225) | 1 |
| 33 | SW1 | B3U-1000P | 1 |
| 34 | U1 | MCP2517FD | 1 |
| 35 | U2 | MCP2561 | 1 |
| 36 | U3 | ATmega1284P-AU | 1 |
| 37 | U4 | NC7SZ04P5X | 1 |
| 38 | U5 | Si8620BC-B-IS | 1 |
| 39 | U6 | LM358AM | 1 |

Bill Of Materials

| Line # | Designator | Comment | Quantity |
|---|---|---|---|
| 40 | U7 | Isolated DC DC Converter | 1 |
| 41 | U8 | LD1117S50CTR | 1 |
| 42 | X1 | Crystal 20MHz | 1 |
| 43 | X2 | ATS16ASM-1 | 1 |

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF . ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF IS

PROPRIETARY AND CONFIDENTIAL

NEXT ASSY | USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL±
ANGULAR: MACH± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

DO NOT SCALE DRAWING

| | NAME | DATE |
|---|---|---|
| DRAWN | | 16/05/2019 |
| CHECKED | | |
| ENG APPR. | | |
| MFG APPR. | | |
| Q.A. | | |

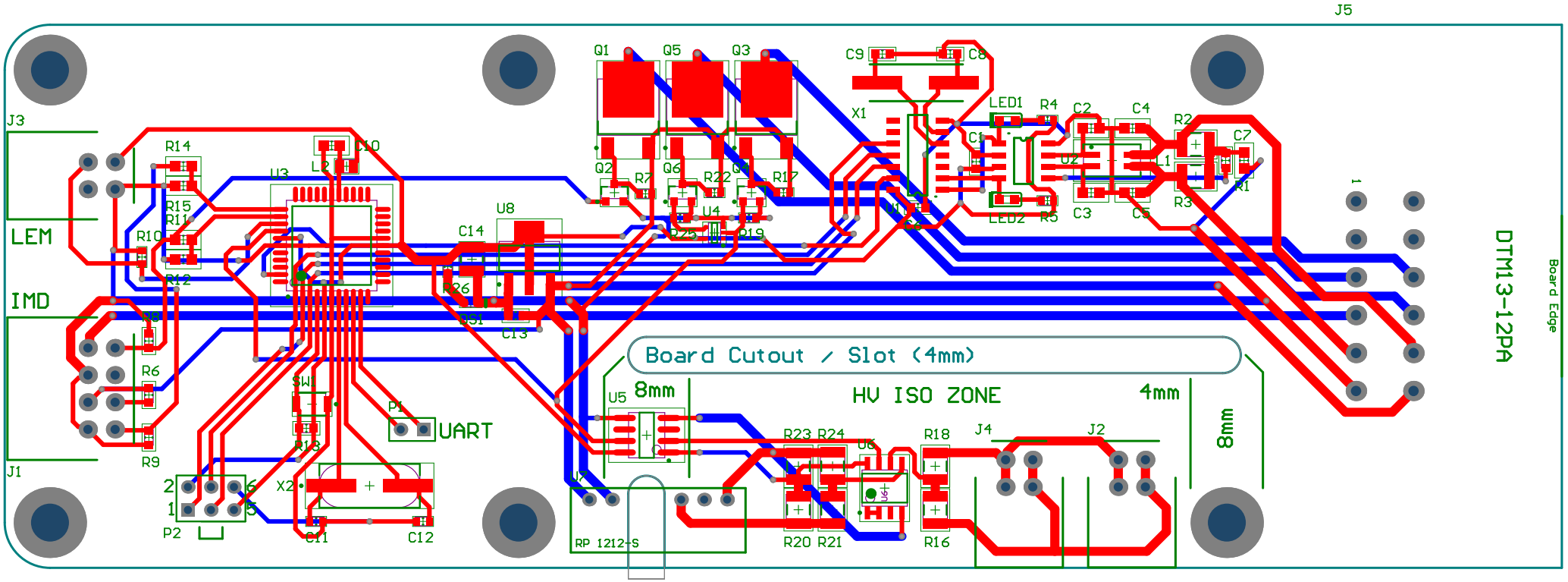
COMMENTS:

TITLE

SIZE | DWG. NO.

SCALE: 1:1 | WEIGHT: | SHEET 3 OF 3

| Comment | Description | Designator | Footprint | LibRef | Quantity |
|---|---|---|---|---|---|
| CAP 100nF 16V 0603 | CAP 100nF 16V ±10% | C1 | CAPC0603(1608)100 | CMP-1035-02584-1 | 1 |
| 1nF | CAP 1nF 16V ±5% 06 | C2 | CAPC0603(1608)100 | CMP-1035-01878-1 | 1 |
| 1nF | CAP 1nF 16V ±5% 06 | C3 | CAPC0603(1608)100 | CMP-1035-01878-1 | 1 |
| 1nF | CAP 1nF 16V ±5% 06 | C4 | CAPC0603(1608)100 | CMP-1035-01878-1 | 1 |
| 1nF | CAP 1nF 16V ±5% 06 | C5 | CAPC0603(1608)100 | CMP-1035-01878-1 | 1 |
| CAP 100nF 16V 0603 | CAP 100nF 16V ±10% | C6 | CAPC0603(1608)100 | CMP-1035-02584-1 | 1 |
| CAP 4.7nF 50V 0603( | CAP 4.7nF 50V ±5% ( | C7 | CAPC0603(1608)100 | CMP-1035-02202-1 | 1 |
| CAP 22pF 16V 0603(1 | CAP 22pF 16V ±5% 0 | C8 | CAPC0603(1608)100 | CMP-1035-00808-1 | 1 |
| CAP 22pF 16V 0603(1 | CAP 22pF 16V ±5% 0 | C9 | CAPC0603(1608)100 | CMP-1035-00808-1 | 1 |
| CAP 100nF 16V 0603 | CAP 100nF 16V ±5% ( | C10 | CAPC0603(1608)100 | CMP-1035-02583-1 | 1 |
| CAP 22pF 16V 0603(1 | CAP 22pF 16V ±1% 0 | C11 | CAPC0603(1608)100 | CMP-1035-00806-1 | 1 |
| CAP 22pF 16V 0603(1 | CAP 22pF 16V ±1% 0 | C12 | CAPC0603(1608)100 | CMP-1035-00806-1 | 1 |
| CAP 100nF 25V 0603 | CAP 100nF 25V ±5% ( | C13 | CAPC0603(1608)100 | CMP-1035-02587-1 | 1 |
| 12103D106KAT2A | Chip Capacitor, 10 u | C14 | CAPC3225X279X50LL | CMP-2000-05477-1 | 1 |
| LTST-C191KGKT | Chip LED, Green, 574 | DS1 | LITE-ON-LTST-C191K | CMP-2000-05198-1 | 1 |
| Microfit 3.0 2x4 | | J1 | Microfit_2X4_R_TH | Microfit_2x4 | 1 |
| Microfit 3.0 2x2 | | J2 | Microfit_2X2_R_TH | Microfit_2x2 | 1 |
| Microfit 3.0 2x2 | | J3 | Microfit_2X2_R_TH | Microfit_2x2 | 1 |
| Microfit 3.0 2x2 | | J4 | Microfit_2X2_R_TH | Microfit_2x2 | 1 |
| DTM12 | | J5 | DTM13-12PA | DTM12 | 1 |
| 744242101 | SMD Common Mode | L1 | WE-SLM | CMP-0222-00021-1 | 1 |
| LQM21FN100M70L | Fixed Inductor, 10 u | L2 | MURA-IND0805_L | CMP-2000-06587-1 | 1 |
| 2V 20mA 0603 Org | LED, SMT, 0603(1608 | LED1 | KING-LED0603-25-O | CMP-0239-00002-1 | 1 |
| 2V 20mA 0603 Org | LED, SMT, 0603(1608 | LED2 | KING-LED0603-25-O | CMP-0239-00002-1 | 1 |
| UART Header | UART Header | P1 | HDR1X2 | Header 2 | 1 |
| Header 3X2 | Header, 3-Pin, Dual r | P2 | HDR2X3 | Header 3X2 | 1 |
| SUD50P06-15-GE3 | P-Channel (D-S) MO | Q1 | VSIL-TO-252AA-3_V | CMP-2000-05431-1 | 1 |
| 2N7002KT1G | Small Signal MOSFET | Q2 | ONSC-SOT-23-3-318- | CMP-1058-00766-1 | 1 |
| SUD50P06-15-GE3 | P-Channel (D-S) MO | Q3 | VSIL-TO-252AA-3_V | CMP-2000-05431-1 | 1 |
| BSS138-7-F | N-Channel Enhancer | Q4 | DIOD-SOT23-3_V | CMP-2000-04930-1 | 1 |
| SUD50P06-15-GE3 | P-Channel (D-S) MO | Q5 | VSIL-TO-252AA-3_V | CMP-2000-05431-1 | 1 |
| BSS138-7-F | N-Channel Enhancer | Q6 | DIOD-SOT23-3_V | CMP-2000-04930-1 | 1 |
| 300R 5% 0603(1608) | 300R 0.1W 5% 0603 | R1 | RESC0603(1608)_N | CMP-1012-00061-1 | 1 |
| 62R | 62R 0.5W 5% 1210 (3 | R2 | RESC1210(3225)_N | CMP-1015-00045-1 | 1 |
| 62R | 62R 0.5W 5% 1210 (3 | R3 | RESC1210(3225)_N | CMP-1015-00045-1 | 1 |
| 100R 5% 0603(1608) | 100R 0.1W 5% 0603 | R4 | RESC0603(1608)_L | CMP-1012-00050-1 | 1 |
| 100R 5% 0603(1608) | 100R 0.1W 5% 0603 | R5 | RESC0603(1608)_L | CMP-1012-00050-1 | 1 |
| 2K2 5% 0603(1608) | 2K2 0.1W 5% 0603 (1 | R6 | RESC0603(1608)_N | CMP-1012-00082-1 | 1 |
| 1K 5% 0603(1608) | 1K 0.1W 5% 0603 (16 | R7 | RESC0603(1608)_L | CMP-1012-00074-1 | 1 |
| 2K2 5% 0603(1608) | 2K2 0.1W 5% 0603 (1 | R8 | RESC0603(1608)_N | CMP-1012-00082-1 | 1 |
| 2K2 5% 0603(1608) | 2K2 0.1W 5% 0603 (1 | R9 | RESC0603(1608)_N | CMP-1012-00082-1 | 1 |
| 1K 5% 0603(1608) | 1K 0.1W 5% 0603 (16 | R10 | RESC0603(1608)_L | CMP-1012-00074-1 | 1 |
| 22K 5% 0603(1608) | 22K 0.1W 5% 0603 (1 | R11 | RESC0603(1608)_M | CMP-1012-00106-1 | 1 |
| 15K 5% 0603(1608) | 15K 0.1W 5% 0603 (1 | R12 | RESC0603(1608)_M | CMP-1012-00102-1 | 1 |
| 10K 5% 0603(1608) | 10K 0.1W 5% 0603 (1 | R13 | RESC0603(1608)_N | CMP-1012-00098-1 | 1 |
| 22K 5% 0603(1608) | 22K 0.1W 5% 0603 (1 | R14 | RESC0603(1608)_M | CMP-1012-00106-1 | 1 |
| 15K 5% 0603(1608) | 15K 0.1W 5% 0603 (1 | R15 | RESC0603(1608)_M | CMP-1012-00102-1 | 1 |
| 9K1 5% 1210(3225) | 9K1 0.5W 5% 1210 (3 | R16 | RESC1210(3225)_N | CMP-1015-00097-1 | 1 |
| 1K 5% 0603(1608) | 1K 0.1W 5% 0603 (16 | R17 | RESC0603(1608)_L | CMP-1012-00074-1 | 1 |
| 1K 5% 1210(3225) | 1K 0.5W 5% 1210 (32 | R18 | RESC1210(3225)_N | CMP-1015-00074-1 | 1 |
| 1K 5% 0603(1608) | 1K 0.1W 5% 0603 (16 | R19 | RESC0603(1608)_L | CMP-1012-00074-1 | 1 |
| 4K7 5% 1210(3225) | 4K7 0.5W 5% 1210 (3 | R20 | RESC1210(3225)_N | CMP-1015-00090-1 | 1 |
| 1K 5% 1210(3225) | 1K 0.5W 5% 1210 (32 | R21 | RESC1210(3225)_N | CMP-1015-00074-1 | 1 |
| 1K 5% 0603(1608) | 1K 0.1W 5% 0603 (16 | R22 | RESC0603(1608)_L | CMP-1012-00074-1 | 1 |
| 3K3 5% 1210(3225) | 3K3 0.5W 5% 1210 (3 | R23 | RESC1210(3225)_N | CMP-1015-00086-1 | 1 |
| 1K 5% 1210(3225) | 1K 0.5W 5% 1210 (32 | R24 | RESC1210(3225)_N | CMP-1015-00074-1 | 1 |
| 1K 5% 0603(1608) | 1K 0.1W 5% 0603 (16 | R25 | RESC0603(1608)_L | CMP-1012-00074-1 | 1 |
| 100R 5% 0603(1608) | 100R 0.1W 5% 0603 | R26 | RESC0603(1608)_L | CMP-1012-00050-1 | 1 |
| B3U-1000P | Ultra-Small Tactile S | SW1 | OMRON-B3U-1000_ | CMP-2100-03586-1 | 1 |
| MCP2517FD | | U1 | MCP2517FD SOIC | MCP2517FD | 1 |
| MCP2561 | | U2 | MCP2561 SOIC | MCP2561 | 1 |
| ATmega1284P-AU | 8-bit AVR Microcont | U3 | 44A_N | CMP-0095-00577-1 | 1 |
| NC7SZ04P5X | TinyLogic(R) UHS Inv | U4 | FAIR-SC70-5_V | CMP-2000-06814-1 | 1 |
| Si8620BC-B-IS | Low-Power Single ar | U5 | SLAB-SOIC-8-NB_M | CMP-0512-00372-1 | 1 |
| LM358AM | Low Power Dual Ope | U6 | D0008A_N | CMP-0055-00796-3 | 1 |
| Isolated DC DC Converter | | U7 | RP1212S | RP-1212S | 1 |
| LD1117S50CTR | Fixed Low Drop Posi | U8 | SOT-223_N | CMP-0244-00311-1 | 1 |
| Crystal 20MHz | | X1 | Crystal 20MHz | Crystal 20MHz | 1 |
| ATS16ASM-1 | ATS-SM Series Quart | X2 | CTS-ATS-SM-XTAL-2 | CMP-0585-00002-2 | 1 |


J5
J3
LEM
IMD
J1
R14
R15
R11
R10
R12
R8
R6
R9
U3
C10
L2
U8
C14
R26
R51
C13
Q1
Q5
Q3
Q2
Q6
Q4
R7
R22
R17
U4
D25
D19
C9
C8
X1
LED1
R4
C2
C4
R2
C7
C1
U2
L1
R1
LED2
R5
C3
C5
R3
Board Cutout / Slot (4mm)
HV ISO ZONE
8mm
4mm
8mm
U5
U6
R23
R24
R18
R20
R21
R16
J4
J2
SW1
R13
P1
UART
P2
X2
C11
C12
U7
RP 1212-S
DTM13-12PA
Board Edge