CANBUS Controller

CANBUS Transciver

U1 MCP2517FD

Pin	Signal
13	CS
10	CLK
11	SDI
12	SDO
6	OSC1
5	OSC2
14	VDD
7	VSS

TXCAN 1 CAN_TX
RXCAN 2 CAN_RX
INT 4
INT0/GPO0 9 INT1
INT1/GPIO1 8 INT2
CLKO/SOF 3

CAN_CS
MCU_CLK
MCU_MOSI
MCU_MISO

CAN_X1_20MHz
CAN_X2_20MHz

+5

C6 CAP 100nF 16V 0603(1608)

GND

CAN_INT

+5

LED1 2V 20mA 0603 Org
LED2 2V 20mA 0603 Org

CAN_TX_LED
CAN_RX_LED

R4 330R 5% 0603(1608)
R5 330R 5% 0603(1608)

C1 CAP 100nF 16V 0603(1608)

+5

U2 MCP2561

TXD 1
RXD 4
STBY 8
VDD 3
VSS 2

SPLIT 5
CANH 7 CAN_P
CANL 6 CAN_N

CAN_SPLIT_R

R1 300R 5% 0603(1608)   CAN_SPLIT

CAN_P

CAN_N

R2 60R4 1% 1210(3225)
R3 60R4 1% 1210(3225)

C7 CAP 4.7nF 50V 0603(1608)

GND

GND

CAN_X1_20MHz 1 X1 2 CAN_X2_20MHz

C8 CAP 22pF 16V 0603(1608)
C9 CAP 22pF 16V 0603(1608)

GND

GND

+12

+12

R6
2K2 5% 0603(1608)

IMD_MEASUREMENT
IMD_MEASUREMENT_LOW

J1
1 5
2 6
3 7
4 8
Microfit 3.0 2x4

IMD_STATUS

R8
2K2 5% 0603(1608)

R9
2K2 5% 0603(1608)

GND_ALT GND

GND

GND

HV HV_GND

J2
1 3
2 4
Microfit 3.0 2x2

IMD_STATUS
- HIGH = No Fault
- LOW = FAILURE

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

Preparing IMD Status signal for harness traversal

+12

R7
1K 5% 0603(1608)

Q1
SUD50P06-15-GE3

IMD_STATUS

Q2
2N7002KT1G

IMD_STATUS_BUFFERED

0, 10V Logic Signal

0, 12V Logic Signal

GND

Wiring diagrams

HV system DC 0...1000 V (-320x only)
HV system DC 0...800 V (-3210 only)

L-

L+

2 1   2 1

2   1
XLA- XLA+

Version V004

3
XK1A

1 Kl.31
2 Kl.15
3 E
4 KE
5 M_HS
6 M_LS
7 NC
8 OK_HS

Kl.31

Notice:
M_HS only on variants -3204 and -3210
M_LS only on variant -3203

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 *

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QUT Motorsport
O-120
O Block
QUT Gardens Point
Brisbane, 4000

NOT USED

TSAL_OPAMP_UNUSED
+5_ISO

U6A
LM358AM

GND_ISO

+5   +5_ISO

TSAL_HV_LOGIC

HV

R16
9K1 5% 1210(3225)

HV_SPLIT   0-HV/10 (0..9V)

R18
1K 5% 1210(3225)

HV_GND

U6B
LM358AM
+5_ISO

GND_ISO

U5
A1   B1
A2   B2
VDD1   GND1
VDD2   GND2
Si8620BC-B-IS

GND_ISO

GND

HV_SENSE_ON   HV_SENSE_OFF

U4A

NC7SZ04P5X

+5   U4B
NC
VCC   GND
NC7SZ04P5X

GND

+12   +12_ISO

U7
+Vin   +Vout
-Vin   -Vout
5.2kV
Isolated DC DC Converter

GND

GND_ISO

+12

R17
1K 5% 0603(1608)

HV_SENSE_ON_MOSFET

Q3
SUD50P06-15-GE3

HV_SENSE_ON   Q4
BSS138-7-F

R19
1K 5% 0603(1608)

GND

TSAL_HV

+12_ISO   +12_ISO

R20
4K7 5% 1210(3225)
+5_ISO

R21
1K 5% 1210(3225)

LV_SPLIT   6V

R23
3K3 5% 1210(3225)

R24
1K 5% 1210(3225)

GND_ISO   GND_ISO

+12

R22
1K 5% 0603(1608)

HV_SENSE_OFF_MOSFET

Q5
SUD50P06-15-GE3

HV_SENSE_OFF   Q6
BSS138-7-F

R25
1K 5% 0603(1608)

GND

TSAL_LV

Op Amp Comparator
If there is +60V present on the HV
line, then the output of the Op Amp
will go High (+5V)

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:*

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QUT Motorsport
O-120
O Block
QUT Gardens Point
Brisbane, 4000

LEM_VREF

LEM_MEASUREMENT

J3
1 3
2 4
Microfit 3.0 2x2

+5

R10
1K 5% 0603(1608)

GND   GND

LEM_MEASUREMENT

R27
4K7 5% 0603(1608)

GND

6
−
7
+
3

12

U9A
LM339D

1

LEM_MEASUREMENT_BOOSTED

R28
6K2 5% 0603(1608)

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

HASS
1 V_ref (IN/OUT)   V_ref (IN/OUT)
2 Output   Output
3 0V R_L=10Kohm 0V
4 +5V   +5V

Operation principle

$+U_C$
V_{out}
V_{ref} (IN/OUT)
$0\ V$
Ip

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.**

+5

4
−
5
+
3

12

U9B
LM339D

2

CAP 100nF 16V 0603(1608)   GND

+5

C2

8
−
9
+
3

12

U9C
LM339D

14

GND

+5

10
−
11
+
3

12

U9D
LM339D

13

GND

Title **QUTMS - HVBoard - LEM**

Size: A4   Number: 4   Revision: *

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QUT Motorsport
O-120
O Block
QUT Gardens Point
Brisbane, 4000

U3 — ATmega1284P-AU

Pin	Name		Pin	Name
40	PB0 (XCK0/T0/PCINT8)		37	PA0 (ADC0/PCINT0)
41	PB1 (T1/CLKO/PCINT9)		36	PA1 (ADC1/PCINT1)
42	PB2 (AIN0/INT2/PCINT10)		35	PA2 (ADC2/PCINT2)
43	PB3 (AIN1/OC0A/PCINT11)		34	PA3 (ADC3/PCINT3)
44	PB4 (SS/OC0B/PCINT12)		33	PA4 (ADC4/PCINT4)
1	PB5 (PCINT13/ICP3/MOSI)		32	PA5 (ADC5/PCINT5)
2	PB6 (PCINT14/OC3A/MISO)		31	PA6 (ADC6/PCINT6)
3	PB7 (PCINT15/OC3B/SCK)		30	PA7 (ADC7/PCINT7)
9	PD0 (PCINT24/RXD0/T3)		19	PC0 (PCINT16/SCL)
10	PD1 (PCINT25/TXD0)		20	PC1 (PCINT17/SDA)
11	PD2 (PCINT/RXD1/26/INT0)		21	PC2 (PCINT18/TCK)
12	PD3 (PCINT/TXD1/27/INT1)		22	PC3 (PCINT19/TMS)
13	PD4 (PCINT28/XCK1/OC1B)		23	PC4 (TDO/PCINT20)
14	PD5 (PCINT29/OC1A)		24	PC5 (TDI/PCINT21)
15	PD6 (PCINT30/OC2B/ICP)		25	PC6 (TOSC1/PCINT22)
16	PD7 (PCINT31/OC2A)		26	PC7 (TOSC2/PCINT23)
4	RESET		5	VCC
7	XTAL2		17	VCC
8	XTAL1		38	VCC
6	GND		27	AVCC
18	GND		29	AREF
28	GND			
39	GND			

Nets:
- CAN_INT — PB0
- CAN_CS — PB3
- MCU_MOSI — PB5
- MCU_MISO — PB6
- MCU_CLK — PB7
- PA0 → HV_SENSE_ON
- PA1 → LEM_MEASUREMENT
- IMD_STATUS
- R11 22K 5% 0603(1608)
- R12 15K 5% 0603(1608)
- GND
- IMD_MEASUREMENT
- R14 22K 5% 0603(1608)
- R15 15K 5% 0603(1608)
- GND

- P1 UART Header (2, 1)
- +5
- R13 10K 5% 0603(1608)
- MCU_LED_A
- MCU_LED_B
- MCU_RESET
- MCU_XTAL_2
- MCU_XTAL_1
- SW1 B3U-1000P
- GND
- GND
- +5
- L2 LQM21FN100M70L
- MCU_AVCC
- C10 CAP 100nF 16V 0603(1608)
- GND

- X2 ATS16ASM-1
- MCU_XTAL_2
- MCU_XTAL_1
- C11 CAP 22pF 16V 0603(1608)
- C12 CAP 22pF 16V 0603(1608)
- GND
- GND

- MCU_LED_A
- R29 330R 5% 0603(1608)
- LED3 2V 20mA 0603 Org
- GND

- MCU_LED_B
- R30 330R 5% 0603(1608)
- LED4 2V 20mA 0603 Org
- GND

- MCU_MISO
- MCU_CLK
- MCU_RESET
- P2 Header 3X2 (1,2 / 3,4 / 5,6)
- +5
- MCU_MOSI
- GND

HV   HV_GND

J4
| 1 | 3 |
| 2 | 4 |
Microfit 3.0 2x2

+12

J5
1	1	12	12
2	2	11	11
3	3	10	10
4	4	9	9
5	5	8	8
6	6	7	7
DTM12

CAN_N

TSAL_LV
IMD_STATUS
IMD_MEASUREMENT

CAN_P
IMD_STATUS_BUFFERED
TSAL_HV
LEM_MEASUREMENT
LEM_MEASUREMENT_BOOSTED

GND_ALT   GND

+12

U8

3 | VIN VOUT | 2
VOUT | 4
GND

LD1117S50CTR

C13
CAP 100nF 25V 0603(1608)

GND

GND

C14
12103D106KAT2A

GND

+5

R26
100R 5% 0603(1608)

PWR_ONLED

DS1
LTST-C191KGKT

GND

A B C D E F

1 | 1

Q1 Q5 Q3
X1
U1 U2
U9
U3
U8
J5
P1
U5
P2 X2
U7

60.00mm
50.00mm
4.00mm
21.51mm
5.00mm
5.00mm
172.01mm
51.75mm
78.25mm
68.88mm
4.00mm

2 | 2

3 | 3

4 | 4

A B C D E F

Top Layer (Scale 1:1)

Bottom Layer (Scale 1:1)

Realistic View

QUT Motorsport
HV Board V1
2019 Rev A

HV ISO ZONE

UART

Realistic View

Realistic View

View from Top side (Scale 2)

Bill Of Materials

Line #	Designator	Name	Quantity
	C1, C2, C6	CAP 100nF 16V 0603(1608)	3
	C7	CAP 4.7nF 50V 0603(1608)	1
	C8, C9	CAP 22pF 16V 0603(1608)	2
	C10	CAP 100nF 16V 0603(1608)	1
	C11, C12	CAP 22pF 16V 0603(1608)	2
	C13	CAP 100nF 25V 0603(1608)	1
	C14	12103D106KAT2A	1
	DS1	LTST-C191KGKT	1
	J1	Microfit 3.0 2x4	1
	J2, J3, J4	Microfit 3.0 2x2	3
	J5	DTM12	1
	L2	LQM21FN100M70L	1
	LED1, LED2, LED3, LED4	2V 20mA 0603 Org	4
	P1	UART Header	1
	P2	Header 3X2	1
	Q1, Q3, Q5	SUD50P06-15-GE3	3
	Q2	2N7002KT1G	1
	Q4, Q6	BSS138-7-F	2
	R1	300R 5% 0603(1608)	1
	R2, R3	60R4 1% 1210(3225)	2
	R4, R5, R29, R30	330R 5% 0603(1608)	4
	R6, R8, R9	2K2 5% 0603(1608)	3
	R7, R10, R17, R19, R22, R25	1K 5% 0603(1608)	6
	R11, R14	22K 5% 0603(1608)	2
	R12, R15	15K 5% 0603(1608)	2

Bill Of Materials

Line #	Designator	Name	Quantity
	R13	10K 5% 0603(1608)	1
	R16	9K1 5% 1210(3225)	1
	R18, R21, R24	1K 5% 1210(3225)	3
	R20	4K7 5% 1210(3225)	1
	R23	3K3 5% 1210(3225)	1
	R26	100R 5% 0603(1608)	1
	R27	4K7 5% 0603(1608)	1
	R28	6K2 5% 0603(1608)	1
	SW1	B3U-1000P	1
	U1	MCP2517FD	1
	U2	MCP2561	1
	U3	ATmega1284P-AU	1
	U4	NC7SZ04P5X	1
	U5	Si8620BC-B-IS	1
	U6	LM358AM	1
	U7	Isolated DC DC Converter	1
	U8	LD1117S50CTR	1
	U9	LM339D	1
	X1	Crystal 20MHz	1
	X2	ATS16ASM-1	1

Comment	Description	Designator	Footprint	LibRef	Quantity
CAP 100nF 16V 0603	CAP 100nF 16V ±10%	C1	CAPC0603(1608)100	CMP-1035-02584-1	1
CAP 100nF 16V 0603	CAP 100nF 16V ±10%	C2	CAPC0603(1608)100	CMP-1035-02584-1	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% 0	C7	CAPC0603(1608)100	CMP-1035-02202-1	1
CAP 22pF 16V 0603(1	CAP 22pF 16V ±5% 06	C8	CAPC0603(1608)100	CMP-1035-00808-1	1
CAP 22pF 16V 0603(1	CAP 22pF 16V ±5% 06	C9	CAPC0603(1608)100	CMP-1035-00808-1	1
CAP 100nF 16V 0603	CAP 100nF 16V ±5% 0	C10	CAPC0603(1608)100	CMP-1035-02583-1	1
CAP 22pF 16V 0603(1	CAP 22pF 16V ±1% 06	C11	CAPC0603(1608)100	CMP-1035-00806-1	1
CAP 22pF 16V 0603(1	CAP 22pF 16V ±1% 06	C12	CAPC0603(1608)100	CMP-1035-00806-1	1
CAP 100nF 25V 0603	CAP 100nF 25V ±5% 0	C13	CAPC0603(1608)100	CMP-1035-02587-1	1
12103D106KAT2A	Chip Capacitor, 10 uF,	C14	CAPC3225X279X50LL	CMP-2000-05477-1	1
LTST-C191KGKT	Chip LED, Green, 574	DS1	LITE-ON-LTST-C191KR	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
LQM21FN100M70L	Fixed Inductor, 10 uH	L2	MURA-IND0805_L	CMP-2000-06587-1	1
2V 20mA 0603 Org	LED, SMT, 0603(1608	LED1	KING-LED0603-25-OR	CMP-0239-00002-1	1
2V 20mA 0603 Org	LED, SMT, 0603(1608	LED2	KING-LED0603-25-OR	CMP-0239-00002-1	1
2V 20mA 0603 Org	LED, SMT, 0603(1608	LED3	KING-LED0603-25-OR	CMP-0239-00002-1	1
2V 20mA 0603 Org	LED, SMT, 0603(1608	LED4	KING-LED0603-25-OR	CMP-0239-00002-1	1
UART Header	UART Header	P1	HDR1X2	Header 2	1
Header 3X2	Header, 3-Pin, Dual ro	P2	HDR2X3	Header 3X2	1
SUD50P06-15-GE3	P-Channel (D-S) MOSF	Q1	VSIL-TO-252AA-3_V	CMP-2000-05431-1	1
2N7002KT1G	Small Signal MOSFET,	Q2	ONSC-SOT-23-3-318-C	CMP-1058-00766-1	1
SUD50P06-15-GE3	P-Channel (D-S) MOSF	Q3	VSIL-TO-252AA-3_V	CMP-2000-05431-1	1
BSS138-7-F	N-Channel Enhancem	Q4	DIOD-SOT23-3_V	CMP-2000-04930-1	1
SUD50P06-15-GE3	P-Channel (D-S) MOSF	Q5	VSIL-TO-252AA-3_V	CMP-2000-05431-1	1
BSS138-7-F	N-Channel Enhancem	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
60R4 1% 1210(3225)	60R4 0.5W 1% 1210 (	R2	RESC1210(3225)_L	CMP-1015-00372-1	1
60R4 1% 1210(3225)	60R4 0.5W 1% 1210 (	R3	RESC1210(3225)_L	CMP-1015-00372-1	1
330R 5% 0603(1608)	330R 0.1W 5% 0603 (	R4	RESC0603(1608)_L	CMP-1012-00062-1	1
330R 5% 0603(1608)	330R 0.1W 5% 0603 (	R5	RESC0603(1608)_L	CMP-1012-00062-1	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
4K7 5% 0603(1608)	4K7 0.1W 5% 0603 (1	R27	RESC0603(1608)_N	CMP-1012-00090-1	1
6K2 5% 0603(1608)	6K2 0.1W 5% 0603 (1	R28	RESC0603(1608)_L	CMP-1012-00093-1	1
330R 5% 0603(1608)	330R 0.1W 5% 0603 (	R29	RESC0603(1608)_L	CMP-1012-00062-1	1
330R 5% 0603(1608)	330R 0.1W 5% 0603 (	R30	RESC0603(1608)_L	CMP-1012-00062-1	1
B3U-1000P	Ultra-Small Tactile Sw	SW1	OMRON-B3U-1000_V	CMP-2100-03586-1	1
MCP2517FD		U1	MCP2517FD SOIC	MCP2517FD	1
MCP2561		U2	MCP2561 SOIC	MCP2561	1
ATmega1284P-AU	8-bit AVR Microcontro	U3	44A_N	CMP-0095-00577-1	1
NC7SZ04P5X	TinyLogic(R) UHS Inve	U4	FAIR-SC70-5_V	CMP-2000-06814-1	1
Si8620BC-B-IS	Low-Power Single and	U5	SLAB-SOIC-8-NB_M	CMP-0512-00372-1	1
LM358AM	Low Power Dual Oper	U6	D0008A_N	CMP-0055-00796-3	1
Isolated DC DC Converter		U7	RP1212S	RP-1212S	1
LD1117S50CTR	Fixed Low Drop Positi	U8	SOT-223_N	CMP-0244-00311-1	1
LM339D	Quad Differential Con	U9	D0014A_L	CMP-2000-06548-1	1
Crystal 20MHz		X1	Crystal 20MHz	Crystal 20MHz	1
ATS16ASM-1	ATS-SM Series Quartz	X2	CTS-ATS-SM-XTAL-2	CMP-0585-00002-2	1