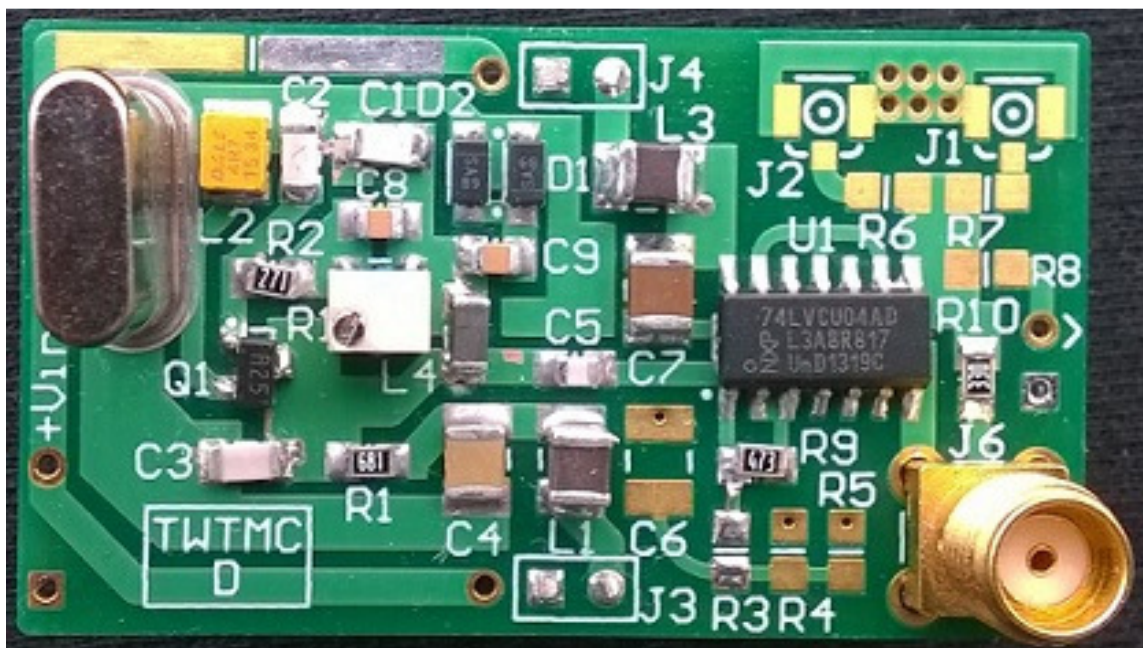# The Well Tempered Master Clock
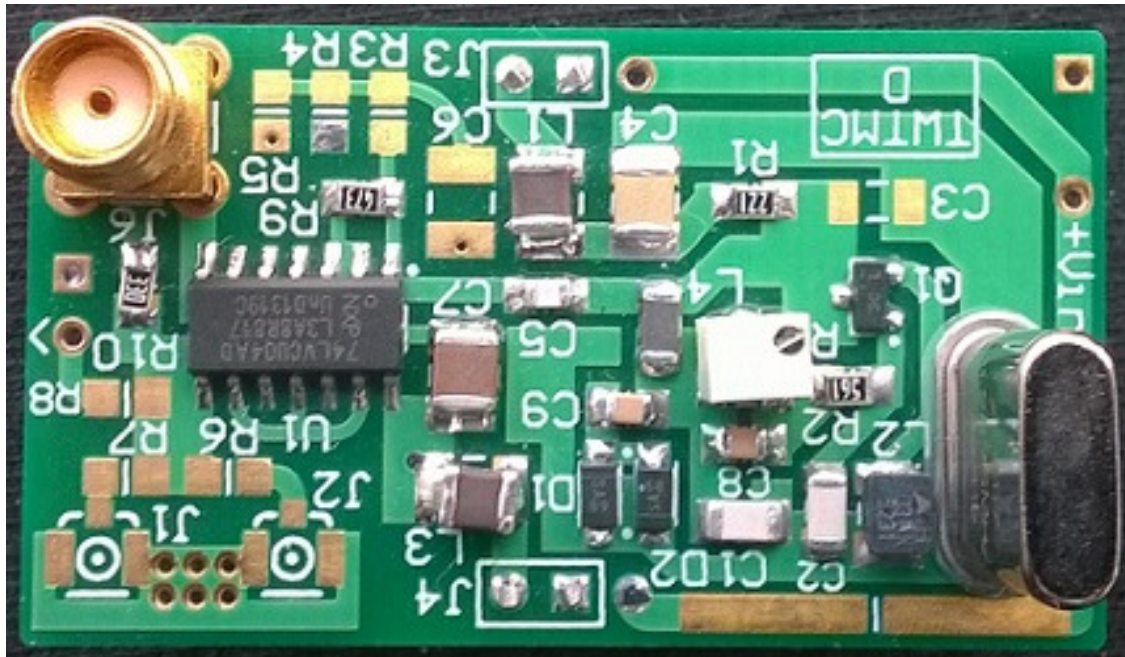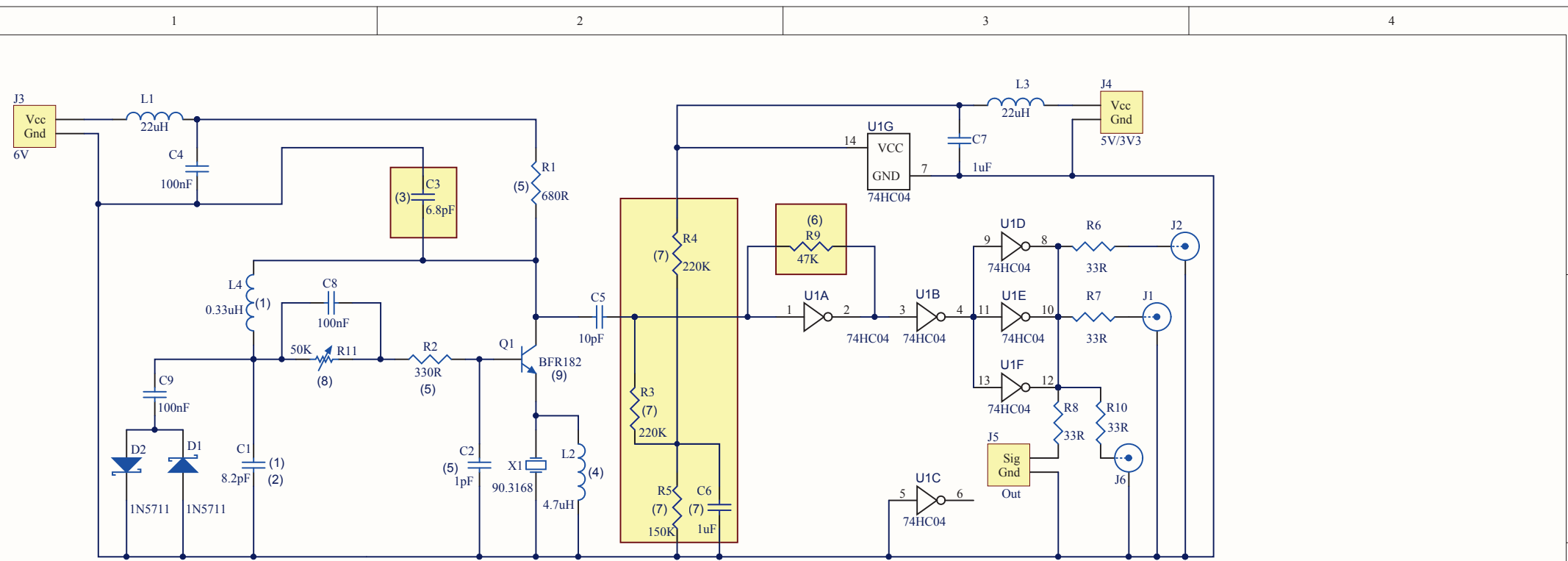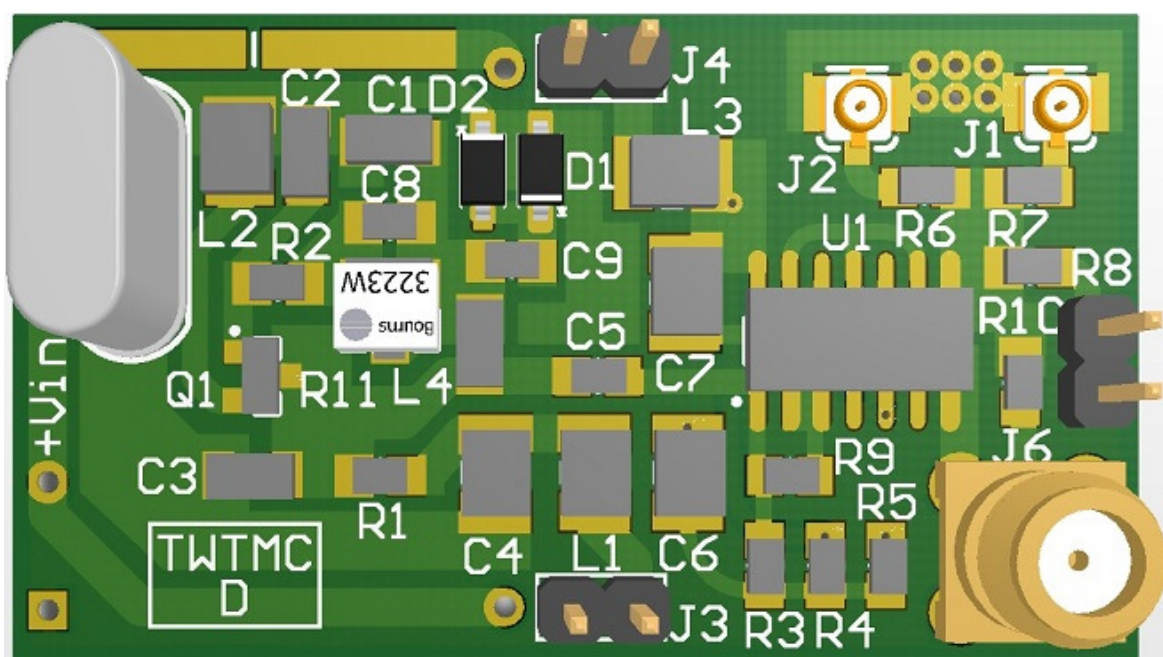# TWTMC-D

Driscoll crystal oscillator

(1) L4-C1 tuned just above the resonance of the crystal

(2) trimmer capacitor for fine tuning

(3) 90-98 MHz AT 11-24 MHz SC - trimmer capacitor for fine adjustment

(4) 2 to 20 times the reactance than what will resonate with the crystal's C0

(5) according to the crystal's frequency and ESR

(6) squarer 1st option 50% duty cycle

(7) squarer 2nd option

(8) adjust for half Vcc at Q1 collector

(9) or NE85633 or MMBT5179 selected for hfe >= 200

Title			
TWTMC-D			
Size	Number		Revision
A4	1		1
Date:	25/05/2016	Sheet 1 of 1	
File:	C:\Users\..\TWTMC-D.SchDoc	Drawn By:	Andrea Mori

PCB layout

BOM

Label	Item	Pkg.	Manufacturer	Manufacturer part	Supplier	Supplier part	Q.ty	Note
C1								(1) L4-C1 tuned just above the resonance of the crystal
C2								(2) according to crystal's frequency
C3								(3) AT 90-98 and SC 11-24 MHz
C4	100nF 100V X7R	1210	AVX	12101C104KAT2A	Mouser	581-12101C104KAT2A	1	
C5	10pF NP0	0805	Kemet	C0805C100J5GACTU	Mouser	80-C0805C100J5G	1	
C6								(4) squarer 2nd option
C7	1uF 100V X7R	1210	AVX	12101C105KAT2A	Mouser	581-12101C105KAT2A	1	
C8 C9	100nF 100V X7R	0805	AVX	08051C104K4T2A	Mouser	581-08051C104K4	2	
R1								(5) according to crystal's ESR
R2								(6) according to crystal's ESR
R3 R4								(4) squarer 2nd option
R5								(4) squarer 2nd option
R6 R7 R8 R10								(7) Q.ty dependent on used outputs
R9								(8) slicer 1st option 50% duty cycle
R11	100k trimmer	3mm	Bourns	3223W-1-104	Mouser	652-3223W-1-104	1	
L1 L3	22uH	1210	Taiyo Yuden	CBC3225T220MR	Mouser	963-CBC3225T220MR	2	
L2								(9) 2 to 20 times the reactance than what will resonate with crystal's C0
L4								(10) L4-C1 tuned just above the resonance of the crystal
X1								(11) according to the selected oscillator frequency
D1 D2	1N5711	SOD123	Diodes Inc.	1N5711W-7-F	Mouser	621-1N5711W-F	2	
Q1								(12) see below
U1								(13) Select for desired output voltage
J1 J2								(14) Q.ty dependent on used outputs
J5								(15) Header output
J6	SMA connector	-	Molex	73391-0070	Mouser	538-73391-0070	1	SMA output
	Crystal insulator		Bivar	CI-192-028	Mouser	749-CI-192-028	1	

(1)								
AT 11.2896 MHz	18pF C0G/NP0	1206	AVX	12061A180FAT2A	Mouser	581-12061A180FAT2A	1	
AT 12.288 MHz	18pF C0G/NP0	1206	AVX	12061A180FAT2A	Mouser	581-12061A180FAT2A	1	
AT 22.5792 MHz	8.2pF C0G/NP0	1206	Kemet	C1206C829J5GACTU	Mouser	80-C1206C829J5G	1	
AT 24.576 MHz	8.2pF C0G/NP0	1206	Kemet	C1206C829J5GACTU	Mouser	80-C1206C829J5G	1	
AT 25.0000 MHz	8.2pF C0G/NP0	1206	Kemet	C1206C829J5GACTU	Mouser	80-C1206C829J5G	1	
AT 5.6448 MHz	24pF C0G/NP0	1206	Kemet	C1206C240J1GACTU	Mouser	80-C1206C240J1G	1	
AT 6.144 MHz	24pF C0G/NP0	1206	Kemet	C1206C240J1GACTU	Mouser	80-C1206C240J1G	1	
AT 16.9344 MHz	12pF C0G/NP0	1206	AVX	12061A120FAT2A	Mouser	581-12061A120FAT2A	1	
AT 33.8688 MHz	7.5pF C0G/NP0	1206	Kemet	C1206C759D5GACTU	Mouser	80-C1206C759D5G	1	
AT 45.1584 MHz	8.2pF C0G/NP0	1206	Kemet	C1206C829J5GACTU	Mouser	80-C1206C829J5G	1	
AT 49.152 MHz	8.2pF C0G/NP0	1206	Kemet	C1206C829J5GACTU	Mouser	80-C1206C829J5G	1	
AT 90.3168 MHz	8.2pF C0G/NP0	1206	Kemet	C1206C829J5GACTU	Mouser	80-C1206C829J5G	1	
AT 98.304 MHz	8.2pF C0G/NP0	1206	Kemet	C1206C829J5GACTU	Mouser	80-C1206C829J5G	1	
SC 11.2896 MHz	18pF C0G/NP0	1206	AVX	12061A180FAT2A	Mouser	581-12061A180FAT2A	1	
SC 22.5792 MHz	12pF C0G/NP0	1206	AVX	12061A120FAT2A	Mouser	581-12061A120FAT2A	1	
SC 24.576 MHz	12pF C0G/NP0	1206	AVX	12061A120FAT2A	Mouser	581-12061A120FAT2A	1	
SC 45.1584 MHz	8.2pF C0G/NP0	1206	Kemet	C1206C829J5GACTU	Mouser	80-C1206C829J5G	1	
SC 49.152 MHz	8.2pF C0G/NP0	1206	Kemet	C1206C829J5GACTU	Mouser	80-C1206C829J5G	1	
SC 90.3168 MHz	9.1pF C0G/NP0	1206	Kemet	C1206C919D5GACTU	Mouser	80-C1206C919D5G	1	
SC 98.304 MHz	8.2pF C0G/NP0	1206	Kemet	C1206C829J5GACTU	Mouser	80-C1206C829J5G	1	

Up to 15 MHz	5-30pF trimmer	3.5 x 3.0	Voltronics	JR300	Mouser	768-JR300	1	Frequency fine adjustment
From 15 to 100 MHz	3-15pF trimmer	3.5 x 3.0	Voltronics	JR150	Mouser	768-JR150	1	Frequency fine adjustment

(2)								
AT 11.2896 MHz	39pF C0G/NP0	1206	AVX	12065A390FAT2A	Mouser	581-12065A390FAT2A	1	
AT 12.288 MHz	39pF C0G/NP0	1206	AVX	12065A390FAT2A	Mouser	581-12065A390FAT2A	1	
AT 22.5792 MHz	22pF C0G/NP0	1206	AVX	12061A220FAT2A	Mouser	581-12061A220FAT2A	1	
AT 24.576 MHz	22pF C0G/NP0	1206	AVX	12061A220FAT2A	Mouser	581-12061A220FAT2A	1	
AT 25.0000 MHz	22pF C0G/NP0	1206	AVX	12061A220FAT2A	Mouser	581-12061A220FAT2A	1	
AT 5.6448 MHz	75pF C0G/NP0	1206	Kemet	C1206C750J1GACTU	Mouser	80-C1206C750J1G	1	
AT 6.144 MHz	75pF C0G/NP0	1206	Kemet	C1206C750J1GACTU	Mouser	80-C1206C750J1G	1	
AT 16.9344 MHz	30pF C0G/NP0	1206	Kemet	C1206C300J5GACTU	Mouser	80-C1206C300J5G	1	
AT 33.8688 MHz	18pF C0G/NP0	1206	AVX	12061A180FAT2A	Mouser	581-12061A180FAT2A	1	
AT 45.1584 MHz	10pF C0G/NP0	1206	AVX	12061A100FAT2A	Mouser	581-12061A100FAT2A	1	
AT 49.152 MHz	10pF C0G/NP0	1206	AVX	12061A100FAT2A	Mouser	581-12061A100FAT2A	1	
AT 90.3168 MHz	1pF C0G/NP0	1206	Kemet	C1206C109C5GACTU	Mouser	80-C1206C109C5G	1	
AT 98.304 MHz	1pF C0G/NP0	1206	Kemet	C1206C109C5GACTU	Mouser	80-C1206C109C5G	1	
SC 11.2896 MHz	15pF C0G/NP0	1206	AVX	12061A150FAT2A	Mouser	581-12061A150FAT2A	1	
SC 22.5792 MHz	5.6 pF NP0	1206	Kemet	C1206C569D2GACTU	Mouser	80-C1206C569D2G	1	
SC 24.576 MHz	5.6 pF NP0	1206	Kemet	C1206C569D2GACTU	Mouser	80-C1206C569D2G	1	
SC 45.1584 MHz	10pF C0G/NP0	1206	AVX	12061A100FAT2A	Mouser	581-12061A100FAT2A	1	

SC 49.152 MHz	10pF C0G/NP0	1206	AVX	12061A100FAT2A	Mouser	581-12061A100FAT2A	1	
SC 90.3168 MHz	1pF C0G/NP0	1206	Kemet	C1206C109C5GACTU	Mouser	80-C1206C109C5G	1	
SC 98.304 MHz	1pF C0G/NP0	1206	Kemet	C1206C109C5GACTU	Mouser	80-C1206C109C5G	1	

(3)								
AT 90.3168 MHz	6.8 pF NP0	1206	Kemet	C1206C689D5GACTU	Mouser	80-C1206C689D5G	1	
AT 98.304 MHz	5.6 pF NP0	1206	Kemet	C1206C569D2GACTU	Mouser	80-C1206C569D2G	1	
SC 11.2896 MHz	15pF C0G/NP0	1206	AVX	12061A150FAT2A	Mouser	581-12061A150FAT2A	1	
SC 22.5792 MHz	12pF C0G/NP0	1206	AVX	12061A120FAT2A	Mouser	581-12061A120FAT2A	1	
SC 24.576 MHz	12pF C0G/NP0	1206	AVX	12061A120FAT2A	Mouser	581-12061A120FAT2A	1	
SC 90.3168 MHz	10pF C0G/NP0	1206	AVX	12061A100FAT2A	Mouser	581-12061A100FAT2A	1	
SC 98.304 MHz	10pF C0G/NP0	1206	AVX	12061A100FAT2A	Mouser	581-12061A100FAT2A	1	
AT and SC	2-10pF trimmer	3.5 x 3.0	Voltronics	JR100	Mouser	768-JR100	1	Output level fine adjustment

(4)								
C6	1uF 100V X7R	1210	AVX	12101C105KAT2A	Mouser	581-12101C105KAT2A	1	
R3 R4	220K 1/10W	0805	Susumu	RR1220P-224-D	Mouser	754-RR1220P-224D	2	
R5 - 5V	180K 1/10W	0805	Susumu	RR1220P-184-D	Mouser	754-RR1220P-184D	1	
R5 - 3V3	150K 1/10W	0805	Susumu	RR1220P-154-D	Mouser	754-RR1220P-154D	1	

(5)								
AT 11.2896 MHz	220R 1/10W	0805	Susumu	RR1220P-221-D	Mouser	754-RR1220P-221D	1	
AT 12.288 MHz	220R 1/10W	0805	Susumu	RR1220P-221-D	Mouser	754-RR1220P-221D	1	
AT 22.5792 MHz	120R 1/10W	0805	Susumu	RR1220P-121-D	Mouser	754-RR1220P-121D	1	
AT 24.576 MHz	120R 1/10W	0805	Susumu	RR1220P-121-D	Mouser	754-RR1220P-121D	1	
AT 25.0000 MHz	120R 1/10W	0805	Susumu	RR1220P-121-D	Mouser	754-RR1220P-121D	1	
AT 5.6448 MHz	100R 1/10W	0805	Susumu	RR1220P-101-D	Mouser	754-RR1220P-101D	1	
AT 6.144 MHz	100R 1/10W	0805	Susumu	RR1220P-101-D	Mouser	754-RR1220P-101D	1	
AT 16.9344 MHz	120R 1/10W	0805	Susumu	RR1220P-121-D	Mouser	754-RR1220P-121D	1	
AT 33.8688 MHz	270R 1/10W	0805	Susumu	RR1220P-271-D	Mouser	754-RR1220P-271D	1	
AT 45.1584 MHz	270R 1/10W	0805	Susumu	RR1220P-271-D	Mouser	754-RR1220P-271D	1	
AT 49.152 MHz	270R 1/10W	0805	Susumu	RR1220P-271-D	Mouser	754-RR1220P-271D	1	
AT 90.3168 MHz	680R 1/10W	0805	Susumu	RR1220P-681-D	Mouser	754-RR1220P-681D	1	
AT 98.304 MHz	680R 1/10W	0805	Susumu	RR1220P-681-D	Mouser	754-RR1220P-681D	1	
SC 11.2896 MHz	1K 1/10W	0805	Susumu	RR1220P-102-D	Mouser	754-RR1220P-102D	1	
SC 22.5792 MHz	1K 1/10W	0805	Susumu	RR1220P-102-D	Mouser	754-RR1220P-102D	1	
SC 24.576 MHz	1K 1/10W	0805	Susumu	RR1220P-102-D	Mouser	754-RR1220P-102D	1	
SC 45.1584 MHz	680R 1/10W	0805	Susumu	RR1220P-681-D	Mouser	754-RR1220P-681D	1	
SC 49.152 MHz	680R 1/10W	0805	Susumu	RR1220P-681-D	Mouser	754-RR1220P-681D	1	
SC 90.3168 MHz	680R 1/10W	0805	Susumu	RR1220P-681-D	Mouser	754-RR1220P-681D	1	
SC 98.304 MHz	680R 1/10W	0805	Susumu	RR1220P-681-D	Mouser	754-RR1220P-681D	1	

(6)								
AT 11.2896 MHz	560R 1/10W	0805	Susumu	RR1220P-561-D	Mouser	754-RR1220P-561D	1	
AT 12.288 MHz	560R 1/10W	0805	Susumu	RR1220P-561-D	Mouser	754-RR1220P-561D	1	
AT 22.5792 MHz	180R 1/10W	0805	Susumu	RR1220P-181-D	Mouser	754-RR1220P-181D	1	
AT 24.576 MHz	180R 1/10W	0805	Susumu	RR1220P-181-D	Mouser	754-RR1220P-181D	1	
AT 25.0000 MHz	180R 1/10W	0805	Susumu	RR1220P-181-D	Mouser	754-RR1220P-181D	1	
AT 5.6448 MHz	330R 1/10W	0805	Susumu	RR1220P-331-D	Mouser	754-RR1220P-331D	1	
AT 6.144 MHz	330R 1/10W	0805	Susumu	RR1220P-331-D	Mouser	754-RR1220P-331D	1	
AT 16.9344 MHz	330R 1/10W	0805	Susumu	RR1220P-331-D	Mouser	754-RR1220P-331D	1	
AT 33.8688 MHz	270R 1/10W	0805	Susumu	RR1220P-271-D	Mouser	754-RR1220P-271D	1	
AT 45.1584 MHz	270R 1/10W	0805	Susumu	RR1220P-271-D	Mouser	754-RR1220P-271D	1	
AT 49.152 MHz	270R 1/10W	0805	Susumu	RR1220P-271-D	Mouser	754-RR1220P-271D	1	
AT 98.304 MHz	270R 1/10W	0805	Susumu	RR1220P-271-D	Mouser	754-RR1220P-271D	1	
SC 11.2896 MHz	330R 1/10W	0805	Susumu	RR1220P-331-D	Mouser	754-RR1220P-331D	1	
SC 22.5792 MHz	330R 1/10W	0805	Susumu	RR1220P-331-D	Mouser	754-RR1220P-331D	1	
SC 24.576 MHz	330R 1/10W	0805	Susumu	RR1220P-331-D	Mouser	754-RR1220P-331D	1	
SC 45.1584 MHz	180R 1/10W	0805	Susumu	RR1220P-181-D	Mouser	754-RR1220P-181D	1	
SC 49.152 MHz	180R 1/10W	0805	Susumu	RR1220P-181-D	Mouser	754-RR1220P-181D	1	
SC 90.3168 MHz	330R 1/10W	0805	Susumu	RR1220P-331-D	Mouser	754-RR1220P-331D	1	
SC 98.304 MHz	330R 1/10W	0805	Susumu	RR1220P-331-D	Mouser	754-RR1220P-331D	1	

(7)								
1 output	33R 1/10W	0805	Susumu	RR1220Q-330-D	Mouser	754-RR1220Q-330D	1	
2 outputs	33R 1/10W	0805	Susumu	RR1220Q-330-D	Mouser	754-RR1220Q-330D	2	
3 outputs	33R 1/10W	0805	Susumu	RR1220Q-330-D	Mouser	754-RR1220Q-330D	3	
4 outputs	33R 1/10W	0805	Susumu	RR1220Q-330-D	Mouser	754-RR1220Q-330D	4	

(8)								
R9	47K 1/10W	0805	Susumu	RR1220P-473-D	Mouser	754-RR1220P-473D	1	

(9)								
AT 11.2896 MHz	330uH	1210	Epcos	B82422H1334K	Mouser	871-B82422H1334K	1	
AT 12.288 MHz	330uH	1210	Epcos	B82422H1334K	Mouser	871-B82422H1334K	1	
AT 22.5792 MHz	82uH	1210	TDK	NLV32T-820J-PF	Mouser	810-NLV32T-820J-PF	1	
AT 24.576 MHz	82uH	1210	TDK	NLV32T-820J-PF	Mouser	810-NLV32T-820J-PF	1	
AT 25.0000 MHz	82uH	1210	TDK	NLV32T-820J-PF	Mouser	810-NLV32T-820J-PF	1	
AT 5.6448 MHz	1mH	1210	Tayo Yuden	CBC3225T102KR	Mouser	963-CBC3225T102KR	1	
AT 6.144 MHz	1mH	1210	Tayo Yuden	CBC3225T102KR	Mouser	963-CBC3225T102KR	1	
AT 16.9344 MHz	220uH	1210	Epcos	B82422H1224K	Mouser	871-B82422H1224K	1	
AT 33.8688 MHz	39uH	1210	TDK	NLV32T-390J-PF	Mouser	810-NLV32T-390J-PF	1	
AT 45.1584 MHz	18uH	1210	TDK	NLV32T-180J-PF	Mouser	810-NLV32T-180J-PF	1	
AT 49.152 MHz	18uH	1210	TDK	NLV32T-180J-PF	Mouser	810-NLV32T-180J-PF	1	
AT 90.3168 MHz	4.7uH	1210	Vishay	IMC1210ER4R7J	Mouser	70-IMC1210ER4R7J	1	
AT 98.304 MHz	4.7uH	1210	Vishay	IMC1210ER4R7J	Mouser	70-IMC1210ER4R7J	1	
SC 11.2896 MHz	470uH	1210	Epcos	B82422H1474K	Mouser	871-B82422H1474K	1	
SC 22.5792 MHz	82uH	1210	TDK	NLV32T-820J-PF	Mouser	810-NLV32T-820J-PF	1	
SC 24.576 MHz	82uH	1210	TDK	NLV32T-820J-PF	Mouser	810-NLV32T-820J-PF	1	
SC 45.1584 MHz	18uH	1210	TDK	NLV32T-180J-PF	Mouser	810-NLV32T-180J-PF	1	
SC 49.152 MHz	18uH	1210	TDK	NLV32T-180J-PF	Mouser	810-NLV32T-180J-PF	1	
SC 90.3168 MHz	5.6uH	1210	Vishay	IMC1210ER5R6K	Mouser	70-IMC1210ER5R6K	1	
SC 98.304 MHz	5.6uH	1210	Vishay	IMC1210ER5R6K	Mouser	70-IMC1210ER5R6K	1	

(10)								
AT 11.2896 MHz	10uH	1206	Vishay	ILSB1206ER100K	Mouser	70-ILSB1206ER100K	1	
AT 12.288 MHz	10uH	1206	Vishay	ILSB1206ER100K	Mouser	70-ILSB1206ER100K	1	
AT 22.5792 MHz	4.7uH	1206	Vishay	ILSB1206ER4R7K	Mouser	70-ILSB1206ER4R7K	1	
AT 24.576 MHz	4.7uH	1206	Vishay	ILSB1206ER4R7K	Mouser	70-ILSB1206ER4R7K	1	
AT 25.0000 MHz	4.7uH	1206	Vishay	ILSB1206ER4R7K	Mouser	70-ILSB1206ER4R7K	1	
AT 5.6448 MHz	33uH	1206	Vishay	ILSB1206ER330K	Mouser	70-ILSB1206ER330K	1	
AT 6.144 MHz	33uH	1206	Vishay	ILSB1206ER330K	Mouser	70-ILSB1206ER330K	1	
AT 16.9344 MHz	6.8uH	1206	Vishay	ILSB1206ER6R8K	Mouser	70-ILSB1206ER6R8K	1	
AT 33.8688 MHz	2.7uH	1206	KOA	MCL2BJTTE2R7K	Mouser	660-MCL2BJTTE2R7K	1	
AT 45.1584 MHz	1.5uH	1206	Vishay	ILSB1206ER1R5K	Mouser	70-ILSB1206ER1R5K	1	
AT 49.152 MHz	1.2uH	1206	Vishay	ILSB1206ER1R2K	Mouser	70-ILSB1206ER1R2K	1	
AT 90.3168 MHz	330nH	1206	Vishay	ILSB1206ERR33K	Mouser	70-ILSB1206ERR33K	1	
AT 98.304 MHz	270nH	1206	Vishay	ILSB1206ERR27K	Mouser	70-ILSB1206ERR27K	1	
SC 11.2896 MHz	10uH	1206	Vishay	ILSB1206ER100K	Mouser	70-ILSB1206ER100K	1	
SC 22.5792 MHz	3.9uH	1206	Vishay	ILSB1206ER3R9K	Mouser	70-ILSB1206ER34R9K	1	
SC 24.576 MHz	3.3uH	1206	Vishay	ILSB1206ER3R3K	Mouser	70-ILSB1206ER34R3K	1	
SC 45.1584 MHz	1.5uH	1206	Vishay	ILSB1206ER1R5K	Mouser	70-ILSB1206ER1R5K	1	
SC 49.152 MHz	1.2uH	1206	Vishay	ILSB1206ER1R2K	Mouser	70-ILSB1206ER1R2K	1	
SC 90.3168 MHz	330nH	1206	Vishay	ILSB1206ERR33K	Mouser	70-ILSB1206ERR33K	1	
SC 98.304 MHz	270nH	1206	Vishay	ILSB1206ERR27K	Mouser	70-ILSB1206ERR27K	1	

(11)								
AT 11.2896 MHz	AT-cut 11.2896 MHz	HC-43/U	Laptech	XT4117	Custom	Custom	1	
AT 12.288 MHz	AT-cut 12.288 MHz	HC-43/U	Laptech	XT4332	Custom	Custom	1	
AT 22.5792 MHz	AT-cut 22.5792 MHz	HC-43/U	Laptech	XT4273	Custom	Custom	1	
AT 24.576 MHz	AT-cut 24.576 MHz	HC-43/U	Laptech	XT4274	Custom	Custom	1	
AT 25.0000 MHz	AT-cut 25.0000 MHz	HC-43/U	Laptech	XT4334	Custom	Custom	1	
AT 5.6448 MHz	AT-cut 5.6448 MHz	HC-43/U	Laptech	XT4272	Custom	Custom	1	
AT 6.144 MHz	AT-cut 6.144 MHz	HC-43/U	Laptech	XT4304	Custom	Custom	1	
AT 16.9344 MHz	AT-cut 16.9344 MHz	HC-43/U	Laptech	XT4333	Custom	Custom	1	
AT 33.8688 MHz	AT-cut 33.8688 MHz	HC-43/U	Laptech	XT4118	Custom	Custom	1	3rd overtone
AT 45.1584 MHz	AT-cut 45.1584 MHz	HC-43/U	Laptech	XT4275	Custom	Custom	1	3rd overtone
AT 49.152 MHz	AT-cut 49.152 MHz	HC-43/U	Laptech	XT4276	Custom	Custom	1	3rd overtone
AT 90.3168 MHz	AT-cut 90.3168 MHz	HC-43/U	Laptech	XT4277	Custom	Custom	1	5th overtone
AT 98.304 MHz	AT-cut 98.304 MHz	HC-43/U	Laptech	XT4278	Custom	Custom	1	5th overtone
SC 11.2896 MHz	SC-cut 11.2896 MHz	HC-43/U	Laptech	XT4335	Custom	Custom	1	3rd overtone
SC 22.5792 MHz	SC-cut 22.5792 MHz	HC-43/U	Laptech	XT4336	Custom	Custom	1	3rd overtone
SC 24.576 MHz	SC-cut 24.576 MHz	HC-43/U	Laptech	XT4337	Custom	Custom	1	3rd overtone
SC 45.1584 MHz	SC-cut 45.1584 MHz	HC-43/U	Laptech	XT4338	Custom	Custom	1	3rd overtone
SC 49.152 MHz	SC-cut 49.152 MHz	HC-43/U	Laptech	XT4339	Custom	Custom	1	3rd overtone
SC 90.3168 MHz	SC-cut 90.3168 MHz	HC-43/U	Laptech	XT4381	Custom	Custom	1	3rd overtone
SC 98.304 MHz	SC-cut 98.304 MHz	HC-43/U	Laptech	XT4382	Custom	Custom	1	3rd overtone

(12)								
AT-Cut up to 50 MHz	MMBT5179	SOT-23	Fairchild	MMBT5179	Mouser	512-MMBT5179	1	
AT-Cut above 50 MHz	BFR182	SOT-23	NXP	BFR 182 E6327	Mouser	726-BFR182E6327	1	
AT-Cut above 50 MHz	NE85633	SOT-23	CEL	NE85633-T1B-R25-A	Mouser	551-NE85633T1BR25A	1	
AT-Cut above 50 MHz	MMBT5179	SOT-23	Fairchild	MMBT5179	Mouser	512-MMBT5179	1	Selected for hfe >= 200
SC-Cut all	BFR182	SOT-23	NXP	BFR 182 E6327	Mouser	726-BFR182E6327	1	
SC-Cut all	NE85633	SOT-23	CEL	NE85633-T1B-R25-A	Mouser	551-NE85633T1BR25A	1	
SC-Cut all	MMBT5179	SOT-23	Fairchild	MMBT5179	Mouser	512-MMBT5179	1	Selected for hfe >= 200

(13)								
5V	74VHC04	SOIC-14	On Semi	MC74VHCU04DR2G	Mouser	863-MC74VHCU04DR2G	1	
3V3	74LVC04	SOIC-14	NXP Semi	74LVCU04AD,118	Mouser	771-LVCU04AD118	1	
3V3	74GU04	SOIC-14	Potato Semi	PO74GU04A	Potato	PO74GU04A	1	

(14)								
1 u.fl. Output	u.fl. Connector		Hirose	U.FL-R-SMT(10)	Mouser	798-U.FL-R-SMT10	1	
2 u.fl. Output	u.fl. Connector		Hirose	U.FL-R-SMT(10)	Mouser	798-U.FL-R-SMT10	2	

(15)								
Vertical	2 pin header r.a.		AMP	826631-2	Mouser	571-826631-2	1	
Horizontal	2 pin header		AMP	826646-2	Mouser	571-826646-2	1	

Assembly guide

The TWTMC-D is a Driscoll crystal oscillator suitable for digital audio.

The board works with fundamental and overtone crystals, AT-Cut and SC-Cut type, and can be used for frequencies from 5 MHz up to 100 MHz.

It needs 2 external power supplies: +6V and +3V3/+5V, depending on the output voltage desired.

The are two options to convert sine wave to TTL, starting from a C-MOS inverter.

The board provides 4 outputs with different connectors: 1 x SMA, 2 x u.fl, 1 x pin strip.

Some component values depend on the crystal operating mode, on the crystal cut mode and on the chosen frequency. The following table shows the values of the components for each frequency.

Frequency	Cut	Mode	C1*	C2	C3*	R1	R2	L2	L4	Q1*
5.6448 MHz	AT	fund	24pF	75pF	none	120R	330R	1mH	33uH	MMBT5179
6.144 MHz	AT	fund	24pF	75pF	none	120R	330R	1mH	33uH	MMBT5179
11.2896 MHz	AT	fund	18pF	39pF	none	220R	560R	330uH	10uH	MMBT5179
12.288 MHz	AT	fund	18pF	39pF	none	220R	560R	330uH	10uH	MMBT5179
16.9344 MHz	AT	fund	12pF	30pF	none	120R	330R	220uH	6.8uH	MMBT5179
22.5792 MHz	AT	fund	8.2pF	22pF	none	120R	180R	82uH	4.7uH	MMBT5179
24.576 MHz	AT	fund	8.2pF	22pF	none	120R	180R	82uH	4.7uH	MMBT5179
25.0000 MHz	AT	fund	8.2pF	22pF	none	120R	180R	82uH	4.7uH	MMBT5179
33.8688 MHz	AT	3rd	7.5pF	18pF	none	270R	270R	39uH	2.7uH	MMBT5179
45.1584 MHz	AT	3rd	8.2pF	10pF	none	270R	270R	18uH	1.5uH	MMBT5179
49.152 MHz	AT	3rd	8.2pF	10pF	none	270R	270R	18uH	1.2uH	MMBT5179
90.3168 MHz	AT	5th	8.2pF	1pF	6.8pF	680R	330R	4.7uH	0.33uH	NE85633
98.304 MHz	AT	5th	8.2pF	1pF	5.6pF	680R	270R	4.7uH	0.27uH	NE85633
11.2896 MHz	SC	3rd	18pF	15pF	15pF	1K	330R	470uH	10uH	NE85633
22.5792 MHz	SC	3rd	12pF	5.6pF	12pF	1K	330R	82uH	3.9uH	NE85633
24.576 MHz	SC	3rd	12pF	5.6pF	12pF	1K	330R	82uH	3.3uH	NE85633
45.1584 MHz	SC	3rd	8.2pF	10pF	none	680R	180R	18uH	1.5uH	NE85633
49.152 MHz	SC	3rd	8.2pF	10pF	none	680R	180R	18uH	1.2uH	NE85633
90.3168 MHz	SC	3rd	9.1pF	1pF	10pF	820R	330R	6.8uH	0.33uH	NE85633
98.304 MHz	SC	3rd	8.2pF	1pF	10pF	820R	330R	6.8uH	0.27uH	NE85633

C1* Due to the tolerance of the components (C1 and L4) this value could need a little adjustment to get precise operating frequency. If you need fine tuning of the frequency you have to replace the capacitor with a trimmer capacitor, as indicated in the BOM.
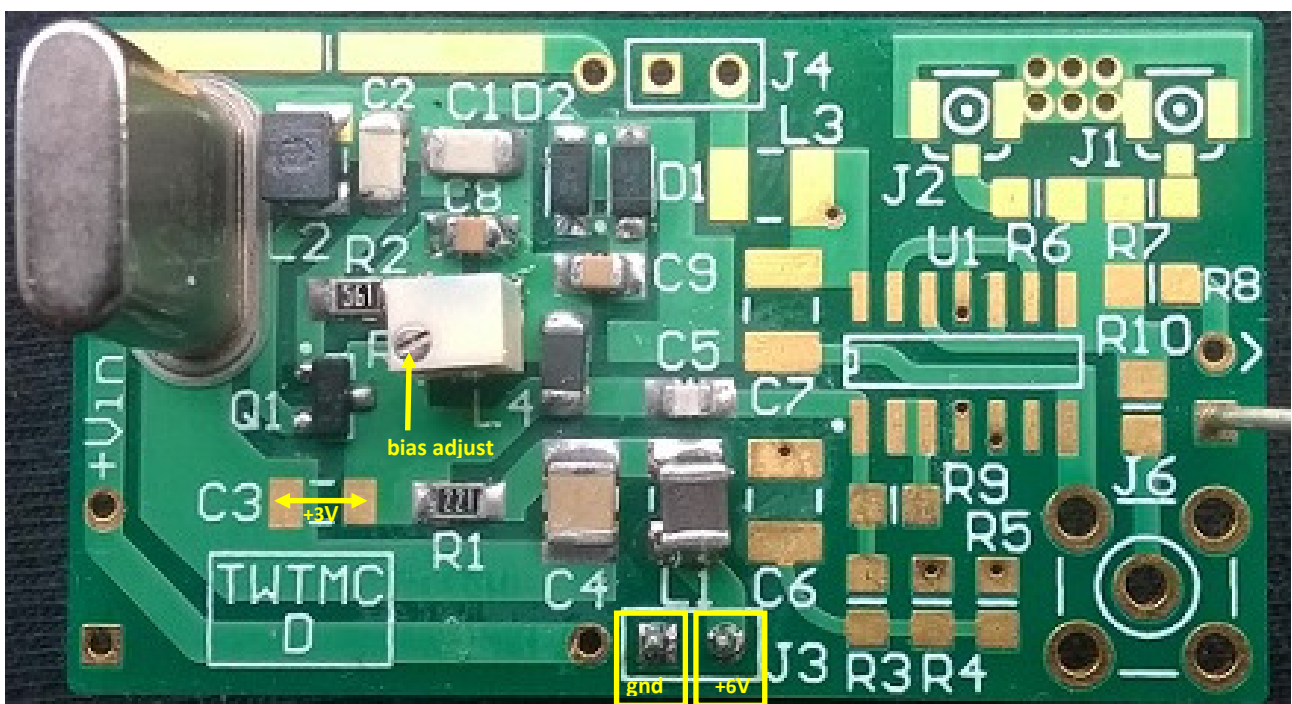
C3* This capacitor has to be used for AT-Cut crystals at frequencies greater than 90 MHz and for SC-Cut crystals at frequencies between 10 and 25 MHz. With AT-Cut crystals it's used to set the maximum output level when the oscillator operates at frequencies around 100 MHz. With SC-Cut crystals it forms a trap to suppress the B-Mode unwanted spurious. If you need fine adjustment of the output level you have to replace the capacitor with a trimmer capacitor, as indicated in the BOM.

Q1* For AT-Cut crystals at frequencies up to 50 MHz, where the ESR of the crystal is relatively low, the MMBT5179 should be used. For AT-Cut crystals at frequencies greater than 50 MHz and for all SC-Cut crystals, where the ESR increases, it should be replaced with the NE85633 or the BFR182. If you would use the MMBT5179 you have to select it for hfe >= 200.

Firstly place the following components: C1, C2, C4, C5, C8, C9, R1, R2, R11, L1, L2, L4, D1, D2, Q1 and X1. **Remember to insert the appropriate insulator between the crystal and the board** (see BOM).

If you are building an oscillator using AT-Cut crystals working around 100 MHz (90.3168 MHz to 98.304 MHz) or SC-Cut crystals working between 10 and 25 MHz (11.2896 MHz to 24.576 MHz), solder C3 following the above table.
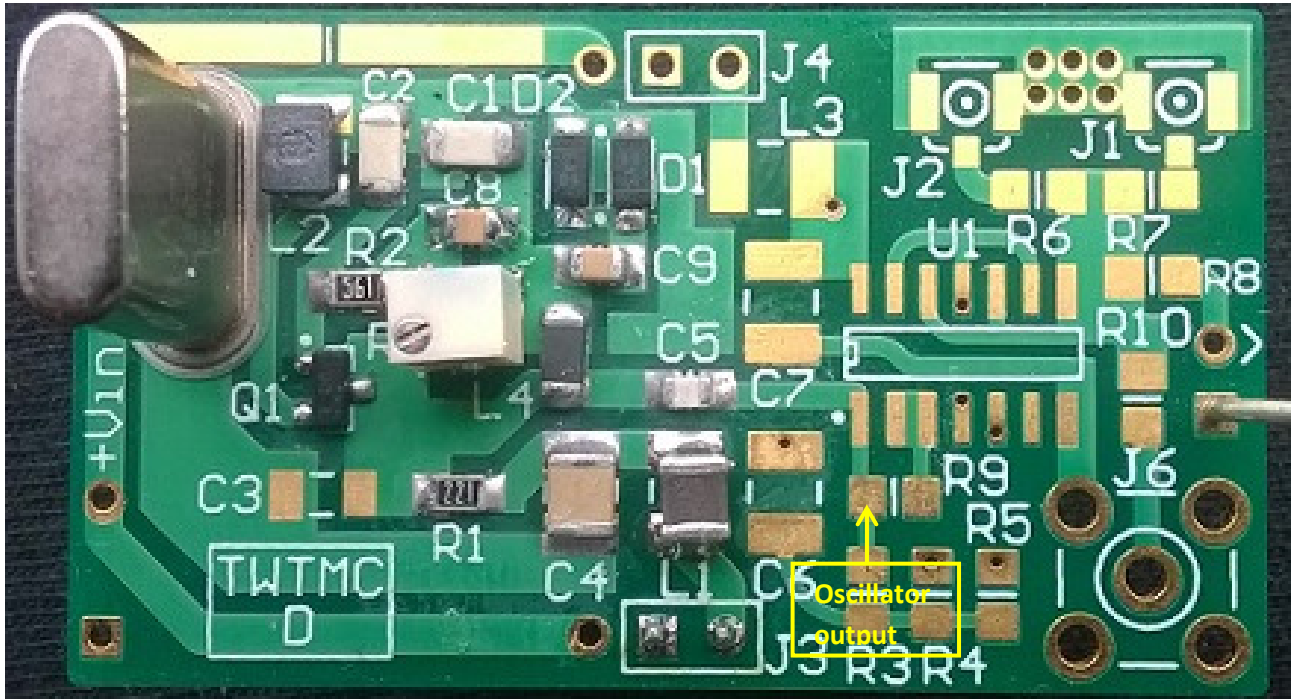
Now you have to set the bjt bias current, adjusting the trimmer resistor R11

Apply +6V as in the above picture.

With a DMM measure the voltage between the collector of Q1 and ground. Adjust the trimmer resistor R11 until you read half Vo, around 3V.

If you own an oscilloscope, you can apply +6V power supply and test the sine waveform. Keep in mind that if you are not using an active probe the waveform could be attenuated because the probe is loading the oscillator. Set the probe to 10X, if possible.

If you are using a trimmer capacitor for C1 you have to adjust it to get the right frequency from the oscillator. To do the job you need an oscilloscope or a frequency counter. Connect the probe to the oscillator output (see above picture) and adjust the trimmer capacitor until you get the oscillator working at the exact frequency.

If you are using a trimmer capacitor for C3 (90/98 MHz oscillators) you have to adjust the output level. To do the job you need an oscilloscope. Connect the probe to the oscillator output (see above picture) and adjust the trimmer capacitor until you get the maximum output level.

Place and solder the following components: L3, C7, U1.

Select the squarer option you desire, following this table:

Option	Type	Components	Duty cycle
1	Self-bias	R9	50%
2	Voltage divider	R3-R4-R5-C6	Configurable

Components listed in the BOM for the second option give around 50% duty cycle, but you can vary their values to get different duty cycle.

Warning. If you are planning to use this oscillator with TWTMC-D&D daughter board, using its feature "power off oscillator" (when the oscillator is not in use), you should select the second slicer option, avoiding to leave U1 input floating. If you desire anyway to use the first slicer option, you should solder also R3 and R5 (they will work as pull-down resistor).

Finally one or more output (up to 4) connectors have to be chosen within the possible options. See the following table:

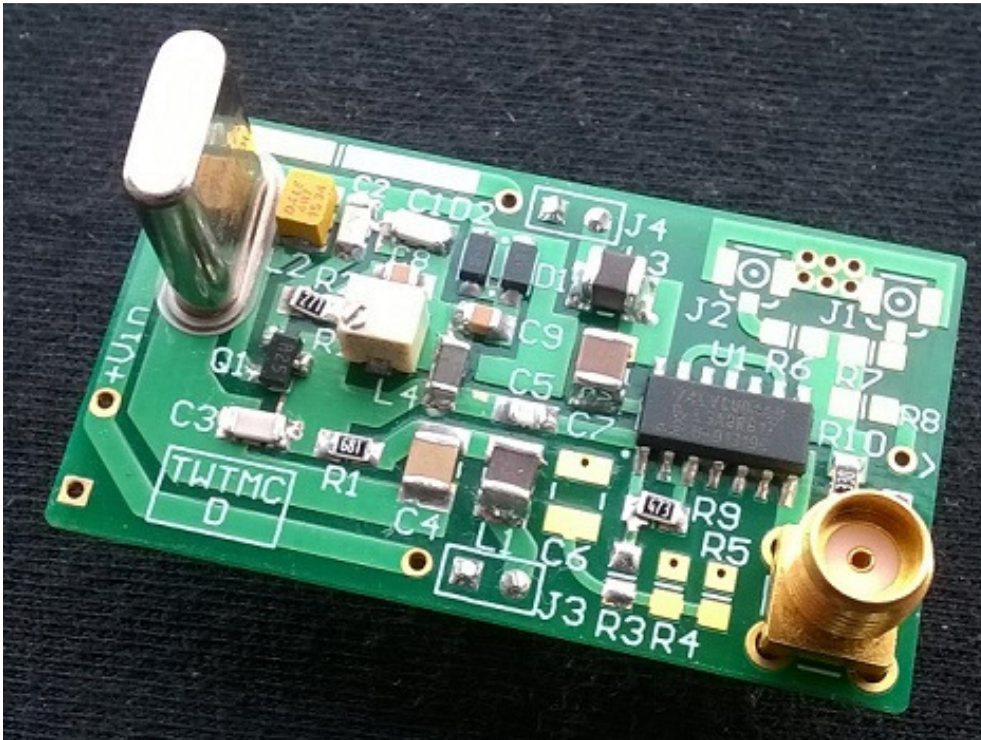| Label	Connector type	Resistor
J1	u.fl	R7
J2	u.fl	R6
J5 (> on board)	pin strip	R8
J6	SMA	R10

Solder connectors and its output resistors.

Solder J3 and J4 pin strip connector for power supply. If you are planning to use external regulators fed by a single DC supply, you have to solder also the connector at the left-bottom corner of the board. The 2 pads at the left-top side are provided to insert a voltage drop resistor, in case the 3V3/5V regulator needs a lower input DC voltage. Otherwise you have to place a jumper (0R0).

If you own an oscilloscope you can check the output waveform. Keep in mind that to display correctly a square wave you need an oscilloscope with high bandwidth and a good probe. As a rule of thumb you can assume a bandwidth at least 9 times larger than the square wave frequency to be displayed. Otherwise you will get a distorted representation.

The crystal oscillator reach its best performance after several weeks of intensive use.

Finished AT-Cut 98.304 MHz oscillator board.

Finished AT-Cut 11.2896 MHz oscillator board.