User Manual

Rev. 2.0

CC1050DK Development Kit

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Introduction

The CC1050 single chip transmitter includes many features and great flexibility, which makes the chip suitable for a very large number of applications and system requirements. The CC1050DK Development Kit is designed to make it very easy for the user to evaluate transmitter performance and in short time develop his own applications.

The Development Kit includes one evaluation board with a complete CC1050 transmitter, voltage regulator and PC interface circuitry. Using the evaluation board connected to a PC running the SmartRF® Studio software, various system parameters can be changed and tested by keystrokes.

Technical features:

- RF power up to 12/8 dBm (433/868 MHz) programmable in 1 dB steps
- Logic level data input (Manchester coded or NRZ)
- Logic level synchronisation clock output
- All set-up controlled by PC
- Selectable 3 V or 4-10 Vunregulated voltage supply inputs

This user manual describes how to get started with the Development Kit. You will also find detailed description of the evaluation board and advice how to develop your own applications. For details on how to use the SmartRF® Studio software please refer to the SmartRF® Studio User Manual.

Your SmartRF® CC1050DK Development Kit should contain the following items:

Kit contents	
Item	*Number of articles*
Evaluation Board (CC5000EB)	1
PC parallel port extension cable (25-pin D-sub, male-female, 3m)	1
Adapter(SMA male-BNC female)	3
Antenna (50Ω, λ/4 monopole, SMA male)	1
Quick Start User Manual	1
CC1050 sample kit	1

The evaluation board includes a significant number of components for great flexibility. However, only a minor part of these components are required in an actual application. Check the datasheet for a typical application circuit.

Evaluation Board

The kit includes an Evaluation Board (CC1050EB) with the following items:

- A SmartRF® CC1050 chip.
- Necessary external surface mounted devices, SMDs, for the chip.
- Voltage regulator 4 –10 V to 3V regulated voltage.
- Possibilities to apply a 3 V voltage source directly (chosen by the switch on the board).
- Voltage-level interface circuits between the CC1050 chip (3 V) and the parallel port of the computer (5 V).
- Connector for a PC parallel port cable.
- Connector for antenna, modulation data in and synchronisation clock out.
- Pin connector for interfacing to MCU

This board is designed for great flexibility so that you can evaluate the circuit performance for several circuit configurations, and in development of your own applications. The evaluation board is distributed in two versions, and the difference is the frequency band of operation. The two versions are optimised for 433 MHz and 868 MHz to cover the two licence free band in Europe. The operating frequency band is marked on the Evaluation Board.

Description

The evaluation circuit board constitutes of three main parts. These are the RF-section, the voltage supply and the PC-interface. The PC-interface contains voltage level shift circuit, which buffers the control lines.

Voltage supply

You can chose between applying a 4-10 V non-regulated supply voltage or a 3 V regulated supply voltage by setting a switch on the board (SPDT). If a non-regulated supply voltage is applied, an on board regulator generates a regulated 3 V supply. A diode prevents damage if wrong polarity is used for the non-regulated input. The connector has five contacts, which is shown below. In addition to the three supply voltage contacts, there are two contacts, which can be used to measure the DC current to the CC1050 chip. A short jumper is placed between these two contacts for the circuit to work. If you want to measure the DC current, replace the jumper with an amperemeter (as shown in the figure below). The current range is from 0 to 26 mA.

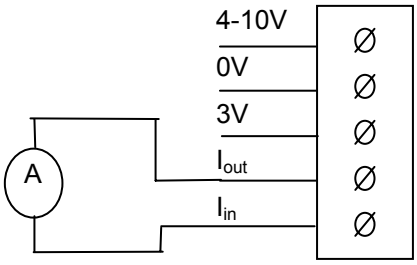


Figure 1: The power connector with an amperemeter attached.

RF-section

The RF section consists of a CC1050 chip with external components. The different components are explained below.

The loop filter

The CC1050 has integrated the loop-filter and shaping features on-chip. For flexibility it is also possible to use an external loop-filter. The PLL loop filter contains the components C5-C6 and R2. However, in most cases the internal filter will give the optimum performance. The loop filter is connected to the same pin as the monitoring of the lock indicator. When external loop-filter is added, the R80 must be removed to avoid conflict with the lock line connected to the parallel port.

The LOCK signal

A LOCK signal is connected to the parallel port interface to be monitored by the software. The signal tells you if the synthesiser frequency is in lock. It is also available at P4, and is active high.

This digital output can also be configured to other functions, as control signal for external PA. Please see the data sheet for details.

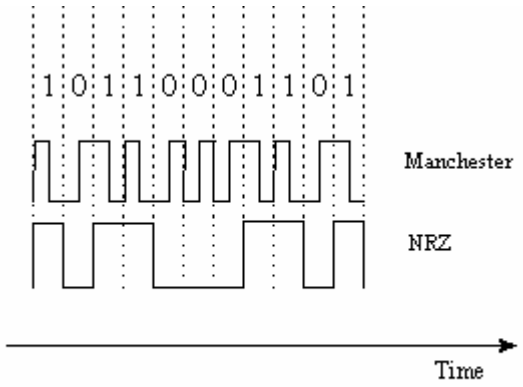
Note: To monitor this signal CC1050 must be configured to take out this signal on CHP_OUT. This is the default setting of SmartRF Studio. If external loop filter is added the lock signal cannot be used due to the loop filter is connected to the same pin.

DI and DCLK

The modulation input (DI) and the synchronisation output (DCLK) is connected to separate connectors. The connectors are of SMA female type. The data to be sent can be of either Manchester or NRZ. The Manchester code ensures that the signal has no DC component. The Manchester code is based on transitions; a “0” is encoded as a low-to-high transition, a “1” is encoded as a high-to-low transition. See figure below. Maximum data-rate is 38.4 kbit/s

giving a baud rate of 76.8 kbaud that is chosen in the software. For NRZ the baud rate is equal to the bit rate and is maximum 76.8 kbit/s.

Please have in mind that the DI line must be of NRZ format even for Manchester mode selection. The encoding to Manchester is in this mode done internally by CC1050.



The CC1050 has an internal clock synchronisation circuit that can be monitored on DCLK. The relationship between DI and DCLK is given in the CC1050 data sheet.

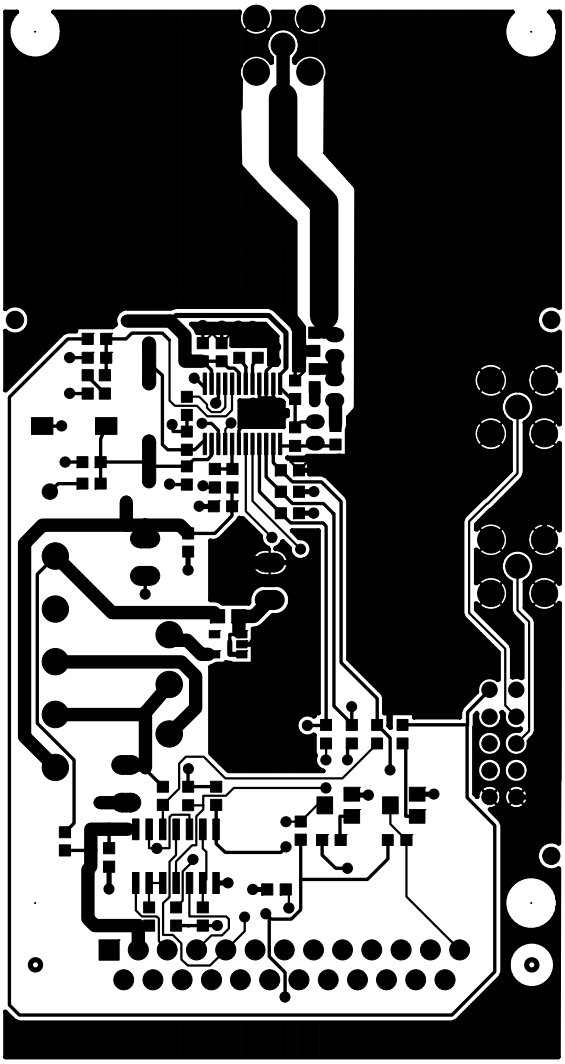
PA matching

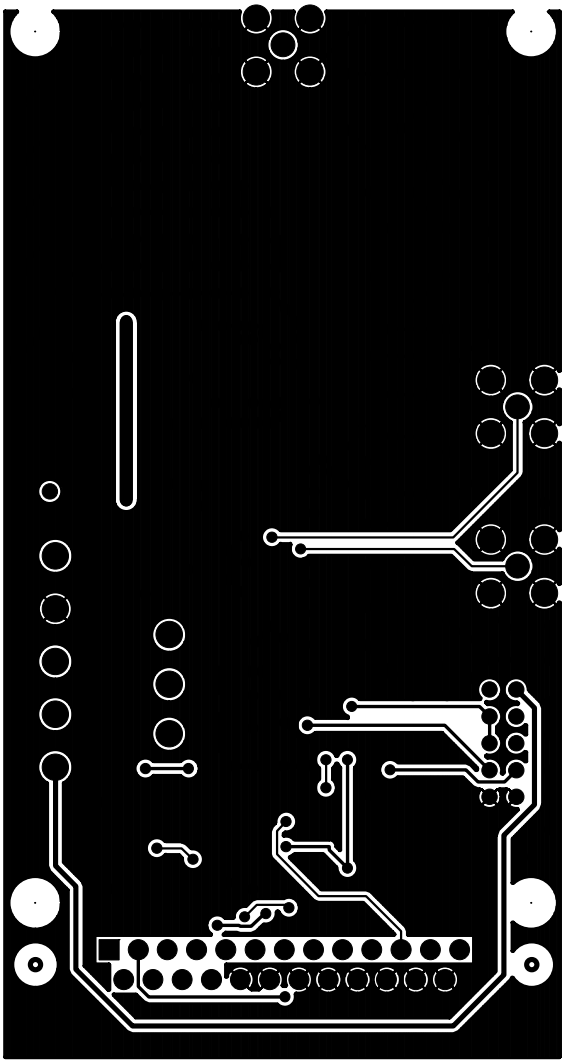
The output-matching network is optimised for either 433 MHz or 868 MHz operation. The component values are calculated in the software program, and consist of L2, C1 and C2. Using the specified component values for the output match will give an optimum match at the specified operating frequency. Minor tuning of the component values may be necessary to compensate for layout parasitics at other frequencies or other layouts. A T-type LC-filter is used for reducing the harmonics. See Application note *AN028 Improved LC-filter* for details.

The crystal oscillator

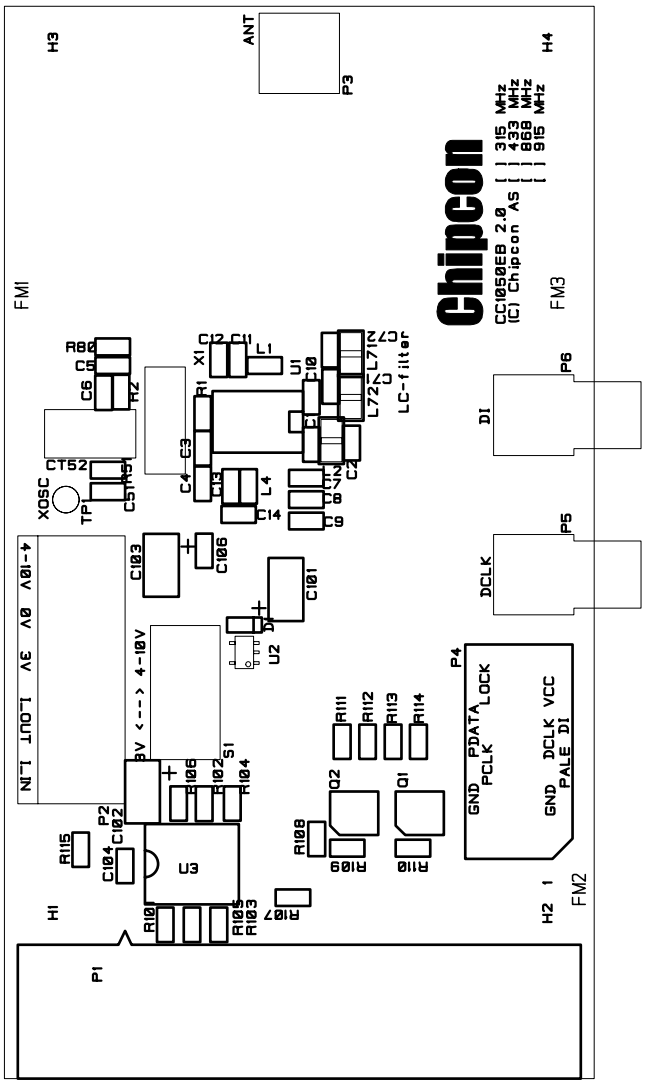
The crystal frequency, X1, is set to 14.7456 MHz. The crystal oscillator circuit has a trimmer capacitor, CT52, which reduces the initial tolerance of the crystal to zero by careful adjustment using a precision frequency counter. The crystal used at this board has ±10 ppm accuracy and ±10 ppm over the –10 to +70 °C temperature range. The crystal oscillator has an AC coupled (C51) test pin for external clock injection, TP1. Be sure to remove the crystal when an external clock is used. The external clock should have amplitude of 1-3 V_{pp}. The loading capacitors are designed for a 16 pF crystal load.

Layout sketches

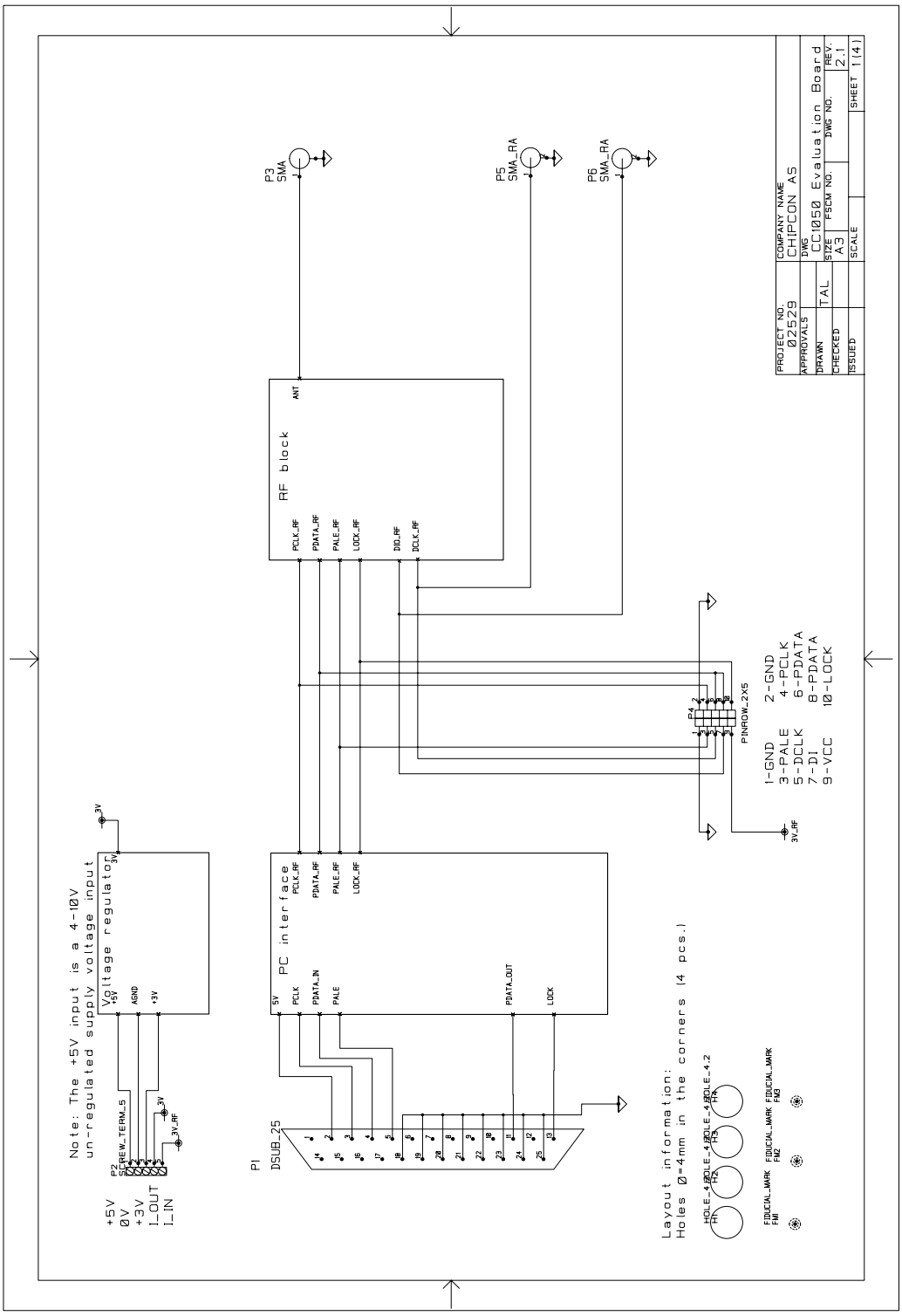


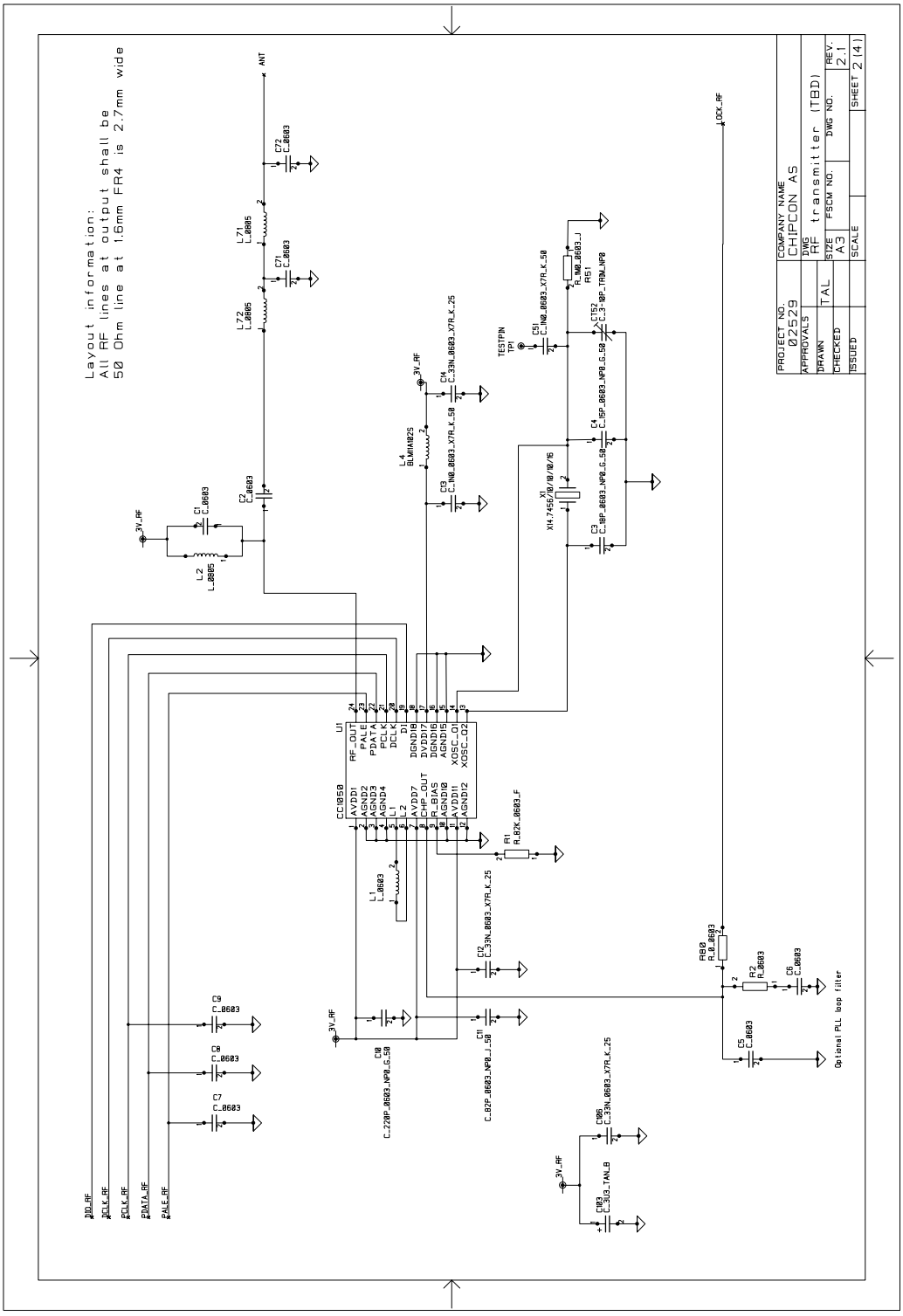


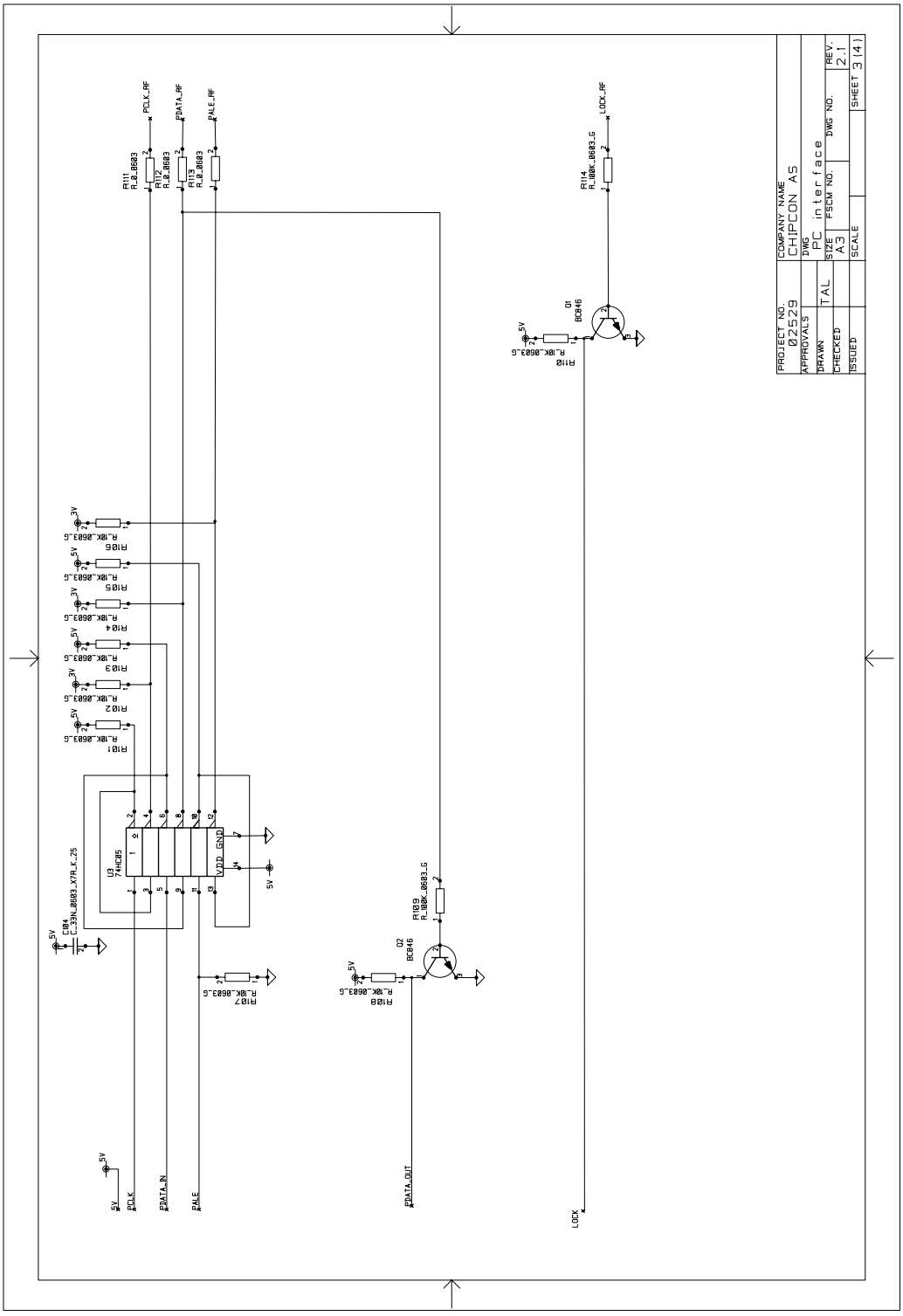
Assembly drawing

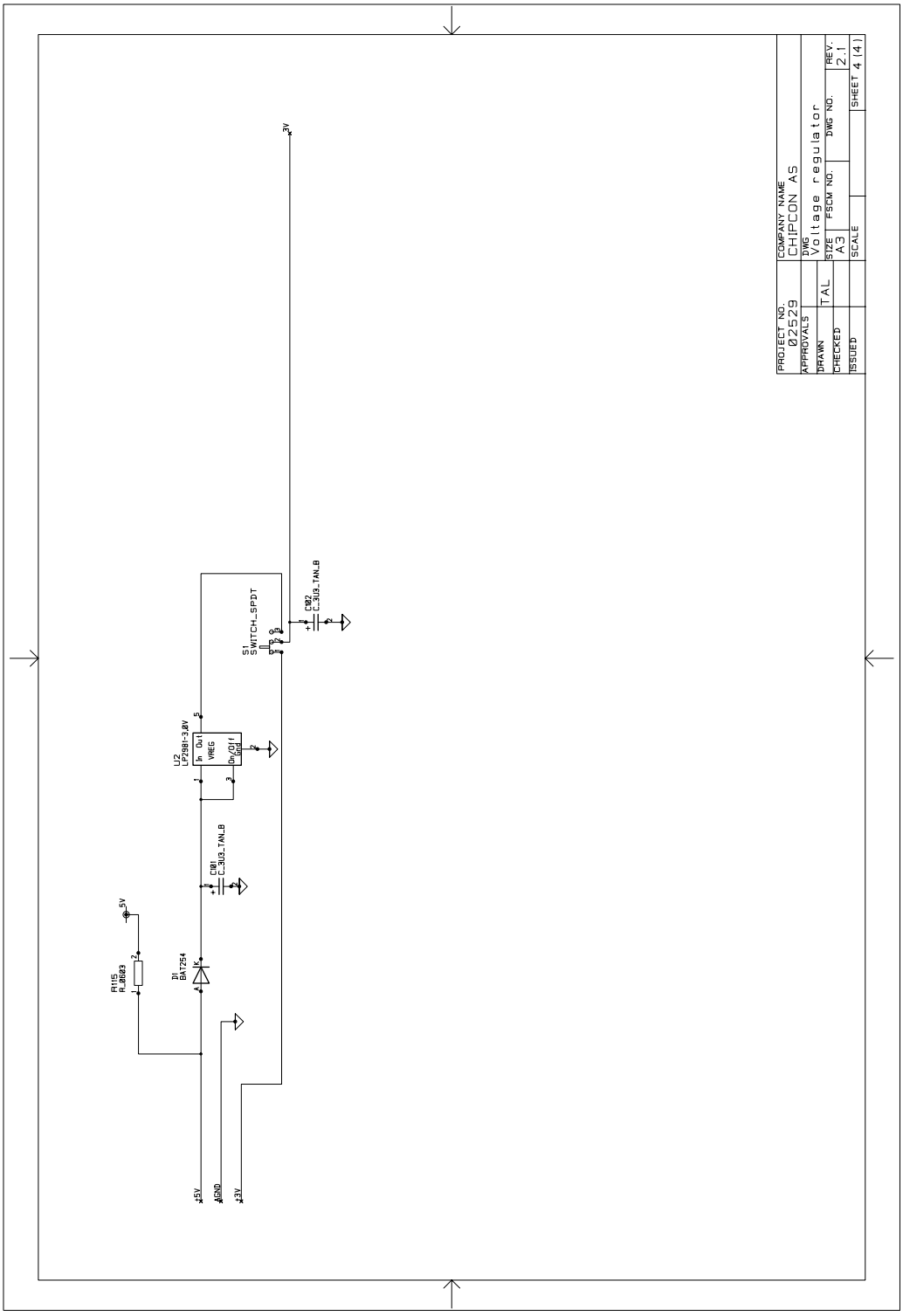


Circuit diagram




Layout information:
All RF lines at output shall be
50 Ohm line at 1.6mm FR4 is 2.7mm wide
ANT
C72 C_0603
L71 L_0805
C71 C_0603
L72 L_0805
C1 C_0603
C2 C_0603
L2 L_0805
3V_RF
L4 BLM18A22S
C3 C_1N0_0603_X7R_K_50
C4 C_33N_0603_X7R_K_25
TESTPIN TP1
C51 C_1N0_0603_X7R_K_50
R51 R_1M0_0603_J
C52 C_0.5P_0603_NP0_0.5P
C4 C_15P_0603_NP0_0.5P
C3 C_18P_0603_NP0_0.5P
X1 X14.7456/10/10/10/6
U1
CC1050
RF_OUT
PALE
PDATA
PCLK
DCLK
DI
DGND18
DVDD17
DGND16
DGND15
XOSC_O1
XOSC_O2
AVDD1
AGND2
AGND3
AGND4
L1
L_2
AVDD7
CHP_OUT
IR_BIAS
AGND10
AVDD11
AGND12
R1 R_82K_0603_F
L1 L_0603
C12 C_33N_0603_X7R_K_25
C10 C_220P_0603_NP0_0.5P
C11 C_82P_0603_NP0_J_50
C9 C_0603
C8 C_0603
C7 C_0603
DCK_RF
RB0 R_0_0603
R2 R_0603
C6 C_0603
C5 C_0603
Optional PLL loop filter
C106 C_33N_0603_X7R_K_25
C103 C_3U3_TAN_B
DD_RF
PCLK_RF
PDATA_RF
PALE_RF
PROJECT NO. 02529
APPROVALS
DRAWN TAL
CHECKED
ISSUED
COMPANY NAME CHIPCON AS
DWG RF transmitter (TBD)
SIZE A3
FSCM NO.
DWG NO.
REV. 2.1
SCALE
SHEET 2 (4)


PROJECT NO.
02529
APPROVALS
DRAWN
CHECKED
ISSUED
COMPANY NAME
CHIPCON AS
DWG
PC interface
SIZE
A3
DWG NO.
REV.
2.1
SCALE
SHEET 3 (4)
TAL
FSCW NO.
PCLK_RF
PDATA_RF
PALE_RF
LOCK_RF
R111
R112
R113
R114
Q1
BC846
Q2
BC846
R109
R108
R107
R106
R105
R104
R103
R102
R101
R110
U3
74HC05
VDD
GND
C104
PCLK
PDATA_IN
PALE
PDATA_OUT
LOCK
5V
3V


PROJECT NO.
02529
APPROVALS
DRAWN
TAL
CHECKED
ISSUED
COMPANY NAME
CHIPCON AS
DWG
Voltage regulator
SIZE
A3
FSCM NO.
DWG NO.
REV.
2.1
SCALE
SHEET 4 (4)
3V
S1
SWITCH_SPDT
C82
C_3U3_TAN_B
U2
LF2981-3.0V
VREG
C81
C_3U3_TAN_B
5V
R115
R_1R83
D1
BAT254
+5V
AGND
+3V

Bill of materials

RF Part 433 MHz			
Reference	*Description*	*Value*	*Part*
C1	Capacitor 0603	12 pF	C_12P_0603_NP0_G_50
C10	Capacitor 0603	220 pF	C_220P_0603_NP0_G_50
C103	Capacitor, tantal	3.3 uF	C_3U3_TAN_B
C106	Capacitor 0603	33 nF	C_33N_0603_X7R_K_25
C11	Capacitor 0603	82 pF	C_82P_0603_NP0_G_50
C12	Capacitor 0603	33 nF	C_33N_0603_X7R_K_25
C13	Capacitor 0603	1 nF	C_1N0_0603_X7R_K_50
C14	Capacitor 0603	33 nF	C_33N_0603_X7R_K_25
C2	Capacitor 0603	6.8 pF	C_6P8_0603_NP0_C_50
C3	Capacitor 0603	18 pF	C_18P_0603_NP0_G_50
C4	Capacitor 0603	15 pF	C_15P_0603_NP0_G_50
C5			Not Used
C51	Capacitor 0603	1 nF	C_1N0_0603_X7R_K_50
C6			Not Used
C7			Not Used
C8			Not Used
C9			Not Used
C71	Capacitor 0603	3.9 pF	C_3P9_0603_NP0_G_50
C72			Not Used
CT52	Trimmer Capacitor		C_3-10P_TRIM_NP0
L1	Inductor, 0603	33 nH	L_33N_0603_KL73
L2	Inductor, 0805	6.2 nH	L_6N2_0805_J
L4	EMI filter bead		BLM18HG102SN1D
L71	Inductor 0805	47 nH	L_47N_0805_J
L72	Inductor 0805	47 nH	L_47N_0805_J
R1	Resistor 0603	82 kΩ	R_82K_0603_F
R2			Not Used
R51			Not Used
R80	Resistor 0603	0 Ω	R_0_0603
TP1	Testpoint		TESTPIN
U1	Single chip transmitter		CC1050
X1	Crystal, HC-49-SMD		X14.7456/10/10/10/16

RF Part 868 MHz			
Reference	*Description*	*Value*	*Part*
C1	Capacitor 0603	4.7 pF	C_4P7_0603_NP0_C_50
C10	Capacitor 0603	220 pF	C_220P_0603_NP0_G_50
C103	Capacitor, tantal	3.3 uF	C_3U3_TAN_B
C106	Capacitor 0603	33 nF	C_33N_0603_X7R_K_25
C11	Capacitor 0603	82 pF	C_82P_0603_NP0_G_50
C12	Capacitor 0603	33 nF	C_33N_0603_X7R_K_25
C13	Capacitor 0603	1 nF	C_1N0_0603_X7R_K_50
C14	Capacitor 0603	33 nF	C_33N_0603_X7R_K_25
C2	Capacitor 0603	5.6 pF	C_5P6_0603_NP0_C_50
C3	Capacitor 0603	18 pF	C_18P_0603_NP0_G_50
C4	Capacitor 0603	15 pF	C_15P_0603_NP0_G_50
C5			Not Used
C51	Capacitor 0603	1 nF	C_1N0_0603_X7R_K_50
C6			Not Used
C7	Capacitor 0603	6.8 pF	C_6P8_0603_NP0_C_50
C8	Capacitor 0603	6.8 pF	C_6P8_0603_NP0_C_50
C9			Not Used
C71	Capacitor 0603	2.2 pF	C_2P2_0603_NP0_C_50
C72	Capacitor 0603	2.2 pF	C_2P2_0603_NP0_C_50
CT52	Trimmer Capacitor		C_3-10P_TRIM_NP0
L1	Inductor, 0603	5.6 nH	L_5N6_0603_KL73
L2	Inductor, 0805	2.5 nH	L_2N5_0805_J
L4	EMI filter bead		BLM18HG102SN1D
L71	Inductor 0805	15 nH	L_15N_0805_J
L72	Inductor 0805	15 nH	L_15N_0805_J
R1	Resistor 0603	82 kΩ	R_82K_0603_F
R2			Not Used
R51			Not Used
R80	Resistor 0603	0 Ω	R_0_0603
TP1	Testpoint		TESTPIN
U1	Single chip transmitter		CC1050
X1	Crystal, HC-49-SMD		X14.7456/10/10/10/16

Voltage Regulator			
Reference	*Description*	*Value*	*Part*
C101	Capacitor, tantal	3.3 uF	C_3U3_TAN_B
C102	Capacitor, tantal	3.3 uF	C_3U3_TAN_B
D1	Diode, Si		BAT254
S1	SPDT switch		SWITCH_SPDT
U2	Voltage regulator		LP2981

PC Interface			
Reference	*Description*	*Value*	*Part*
C104	Capacitor 0603	33 nF	C_33N_0603_X7R_K_25
Q1	BJT, Si, NPN, small signal		BC846
Q2	BJT, Si, NPN, small signal		BC846
R101	Resistor 0603	10 kΩ	R_10K_0603_G
R102	Resistor 0603	10 kΩ	R_10K_0603_G
R103	Resistor 0603	10 kΩ	R_10K_0603_G
R104	Resistor 0603	10 kΩ	R_10K_0603_G
R105	Resistor 0603	10 kΩ	R_10K_0603_G
R106	Resistor 0603	10 kΩ	R_10K_0603_G
R107	Resistor 0603	10 kΩ	R_10K_0603_G
R108	Resistor 0603	10 kΩ	R_10K_0603_G
R109	Resistor 0603	100 kΩ	R_100K_0603_G
R110	Resistor 0603	10 kΩ	R_10K_0603_G
R111	Resistor 0603	0 kΩ	R_0_0603
R112	Resistor 0603	0 kΩ	R_0_0603
R113	Resistor 0603	0 kΩ	R_0_0603
R114	Resistor 0603	100 kΩ	R_100K_0603_G
R115			Not Used
U3	Hex inverter, oc		74HC05

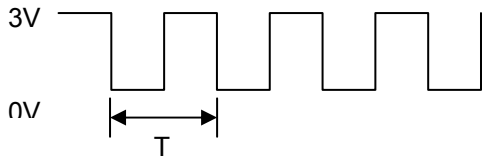
Evaluation board			
Reference	*Description*	*Value*	*Part*
H1	Circuit Board Support		Distance 12.5mm
H2	Circuit Board Support		Distance 12.5mm
H3	Circuit Board Support		Distance 12.5mm
H4	Circuit Board Support		Distance 12.5mm
P1	D-Sub, 25 pin		DSUB_25
P2	5 pin terminal, screw		SCREW_TERM_5
P3	SMA connector		SMA (Straight)
P4	Pinrow, 2x5		PINROW_2X5
P5	SMA connector		SMA_RA (Right angle)
P6	SMA connector		SMA_RA (Right angle)

Note: Items shaded are different for different frequencies

Using the Development Kit

The purpose of the Development Kit is to give users of the integrated transmitter CC1050 hands-on experience with the chip. A typical set-up of the evaluation board is shown below. The evaluation board is connected to a PC to be programmed by the SmartRF Studio software. You can also easily connect your MCU to the 10-pin connector P4, and implement prototype software without doing hardware design. R111-R113 should be removed when connecting your MCU to P4.

The data signal that you want to send in transmit mode can be of either Manchester or NRZ code. A square wave from a function generator can be used to generate this data. The signal source shall be connected to the Data I/O port (DI) at the evaluation board. The signal must be a square wave from 0 to 3V as shown. Do not apply a 5V signal because it can damage the CC1050 chip. The signal from the function generator will represent either zeroes or ones, and the bit rate in Manchester coded will be 1/T, where T is the period time. For the NRZ case, the bit rate is given by 2/T due to the fact that the bit rate is equal to the baud rate in NRZ.



The transmitted signal can be studied on a spectrum analyser, sent out on the antenna (see note below).

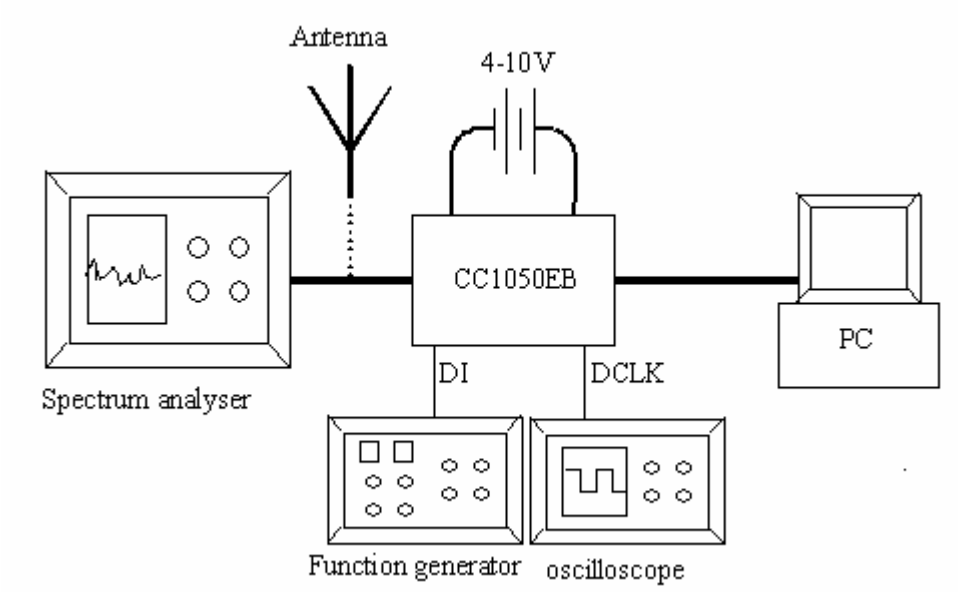


Figure 2: Equipment set-up in transmit mode.

Important: The use of radio transmitters is regulated by international and national rules. Before transmitting a RF signal out on the antenna, please contact your local telecommunication authorities to check if you are licensed to operate the transmitter.

Address Information

Web site:	http://www.chipcon.com
E-mail:	wireless@chipcon.com
Technical Support Email:	support@chipcon.com
Technical Support Hotline:	+47 22 95 85 45

Headquarters:

Chipcon AS
Gaustadalléen 21
NO-0349 Oslo
NORWAY
Tel: +47 22 95 85 44
Fax: +47 22 95 85 46
E-mail: wireless@chipcon.com

US Offices:

Chipcon Inc., Western US Sales Office
19925 Stevens Creek Blvd.
Cupertino, CA 95014-2358
USA
Tel: +1 408 973 7845
Fax: +1 408 973 7257
Email: USsales@chipcon.com

Chipcon Inc., Eastern US Sales Office
35 Pinehurst Avenue
Nashua, New Hampshire, 03062
USA
Tel: +1 603 888 1326
Fax: +1 603 888 4239
Email: eastUSsales@chipcon.com

Sales Office Germany:

Chipcon AS
Riedberghof 3
D-74379 Ingersheim
GERMANY
Tel: +49 7142 9156815
Fax: +49 7142 9156818
Email: Germanysales@chipcon.com

Sales Office Asia :

Chipcon Asia Pasific
37F, Asem Tower
159-1 Samsung-dong, Kangnam-ku
Seoul 135-798 Korea
Tel: +82 2 6001 3888
Fax: +82 2 6001 3711
Email: Asiasales@chipcon.com

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OCEAN CHIPS
Океан Электроники
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- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «**JONHON**», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «**FORSTAR**».

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«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

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«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).

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Телефон: 8 (812) 309-75-97 (многоканальный)
Факс: 8 (812) 320-03-32
Электронная почта: ocean@oceanchips.ru
Web: http://oceanchips.ru/
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А