# User Manual

**Rev. 2.0**

# CC1050DK Development Kit

# Table of contents

**INTRODUCTION ..... 3**
**EVALUATION BOARD ..... 4**
DESCRIPTION ..... 4
LAYOUT SKETCHES ..... 7
ASSEMBLY DRAWING ..... 9
CIRCUIT DIAGRAM ..... 10
BILL OF MATERIALS ..... 114
**USING THE DEVELOPMENT KIT ..... 17**

## 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.

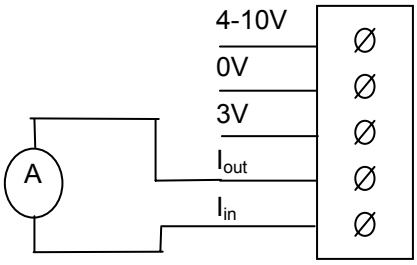



**Figure 1: The power connector with an amperemeter attached.**

*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.

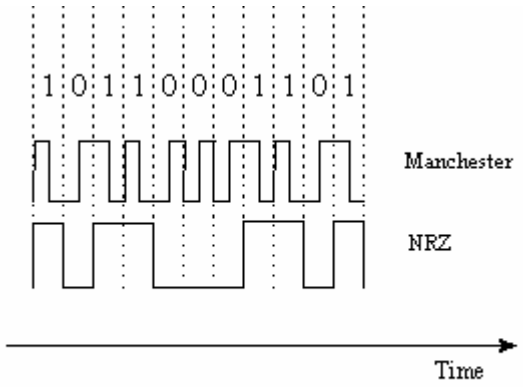
Note: To monitor this signal CC1050 must be configured to take out this signal on CHP_OUT. This is the default setting of SmartRF Studio. If external loop filter is added the lock signal cannot be used due to the loop filter is connected to the same pin.

*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.

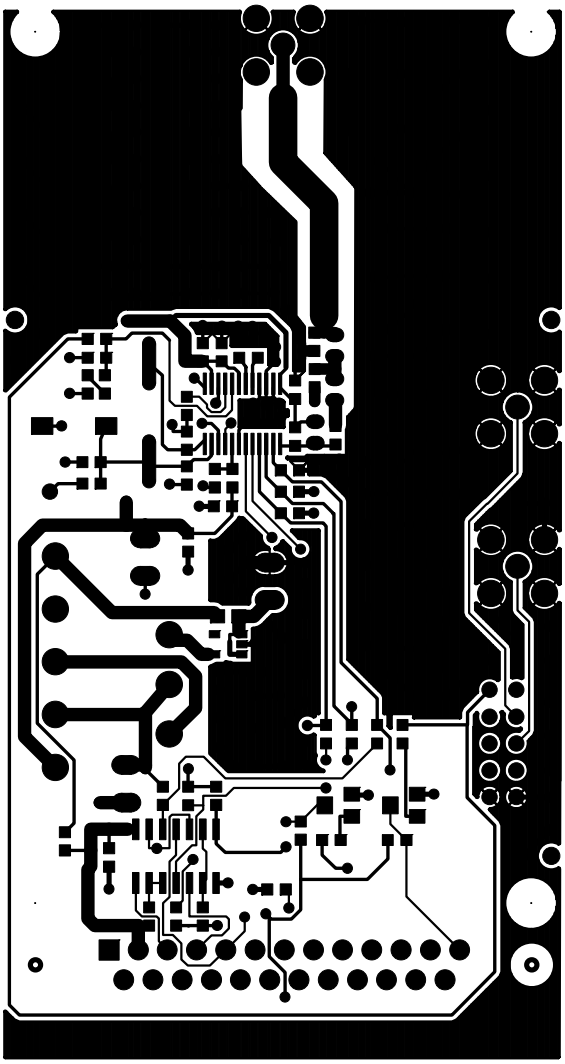
*PA matching*

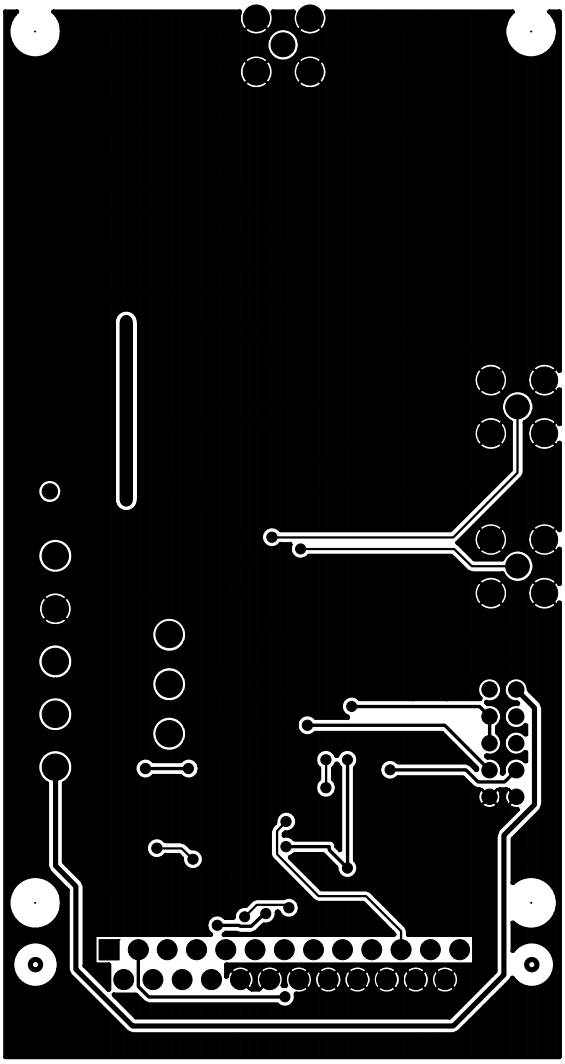
The output-matching network is optimised for either 433 MHz or 868 MHz operation. The component values are calculated in the software program, and consist of L2, C1 and C2. Using the specified component values for the output match will give an optimum match at the specified operating frequency. Minor 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*

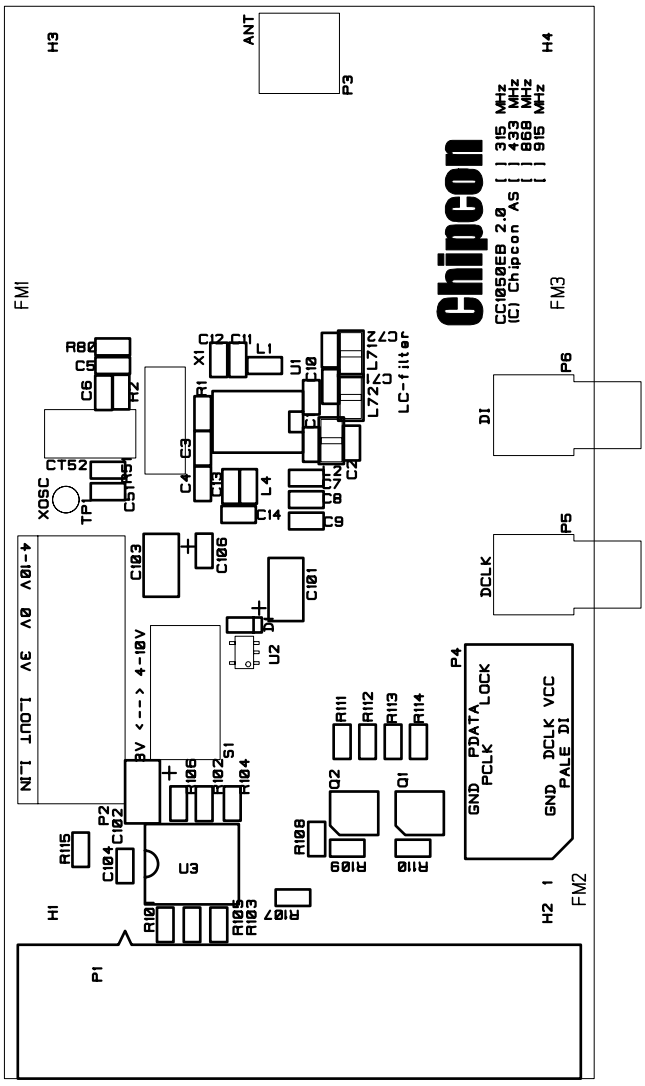
The crystal frequency, X1, is set to 14.7456 MHz. The crystal oscillator circuit has a trimmer capacitor, CT52, which reduces the initial tolerance of the crystal to zero by careful adjustment using a precision frequency counter. The crystal used at this board has ±10 ppm accuracy and ±10 ppm over the –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**

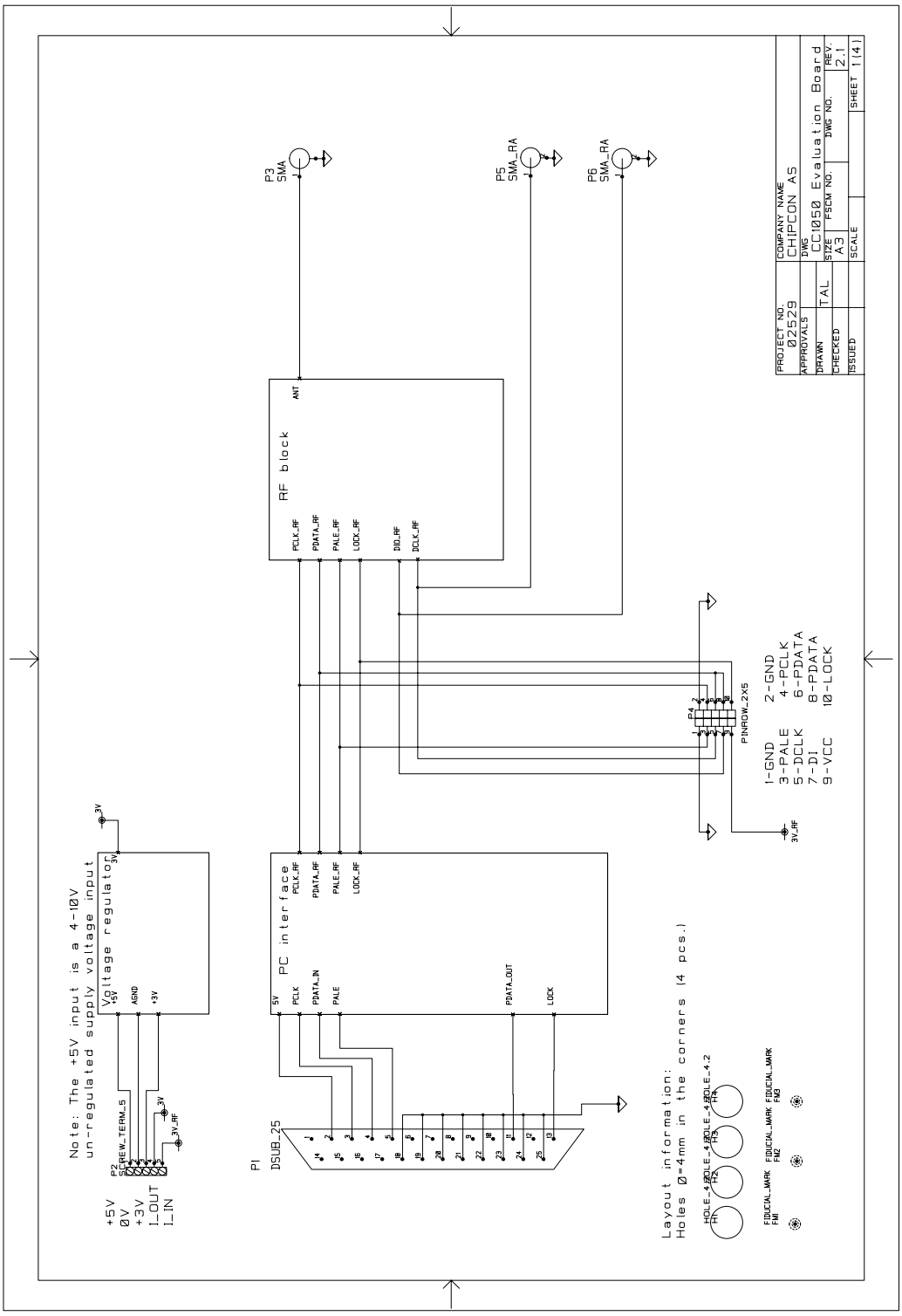


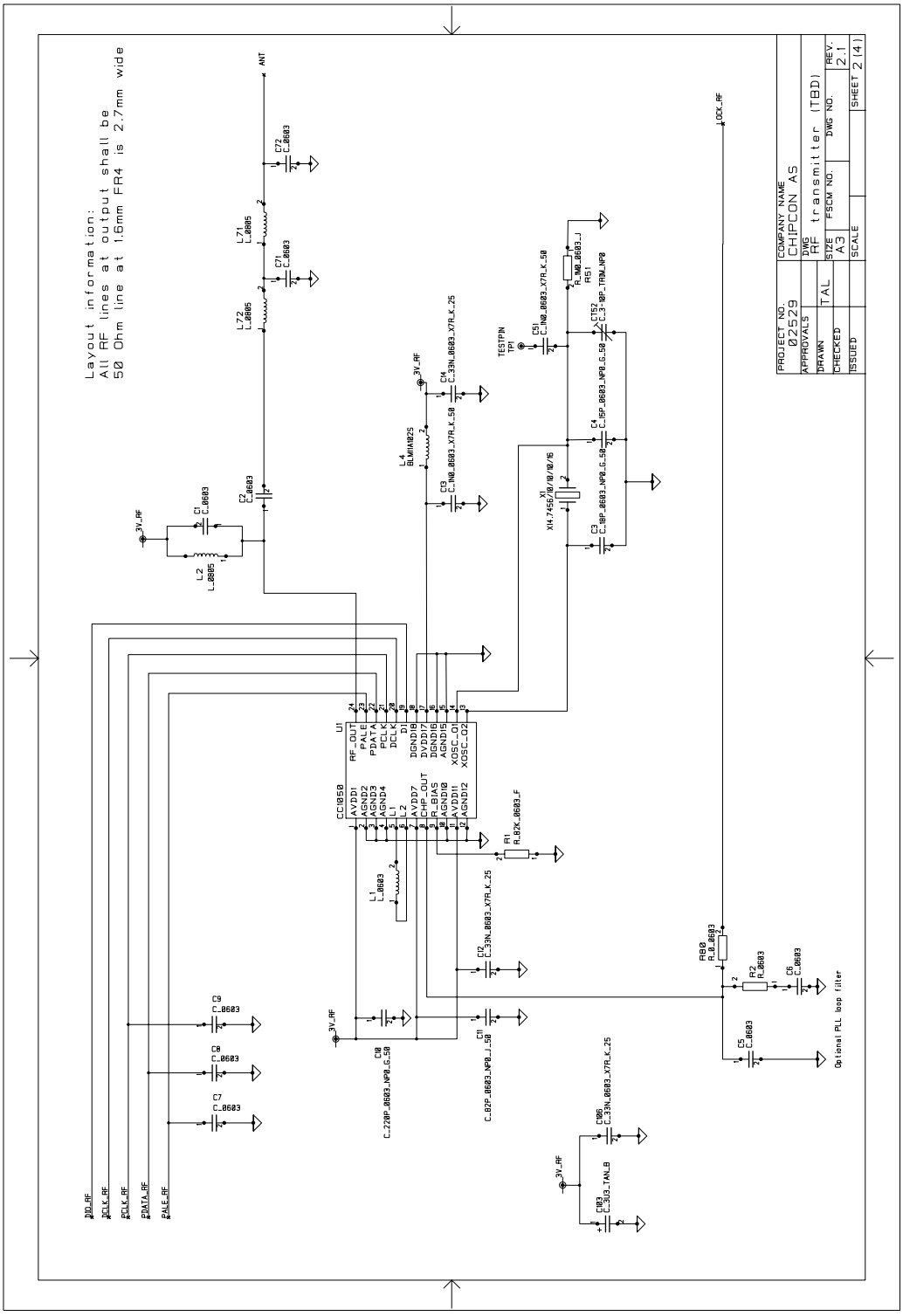


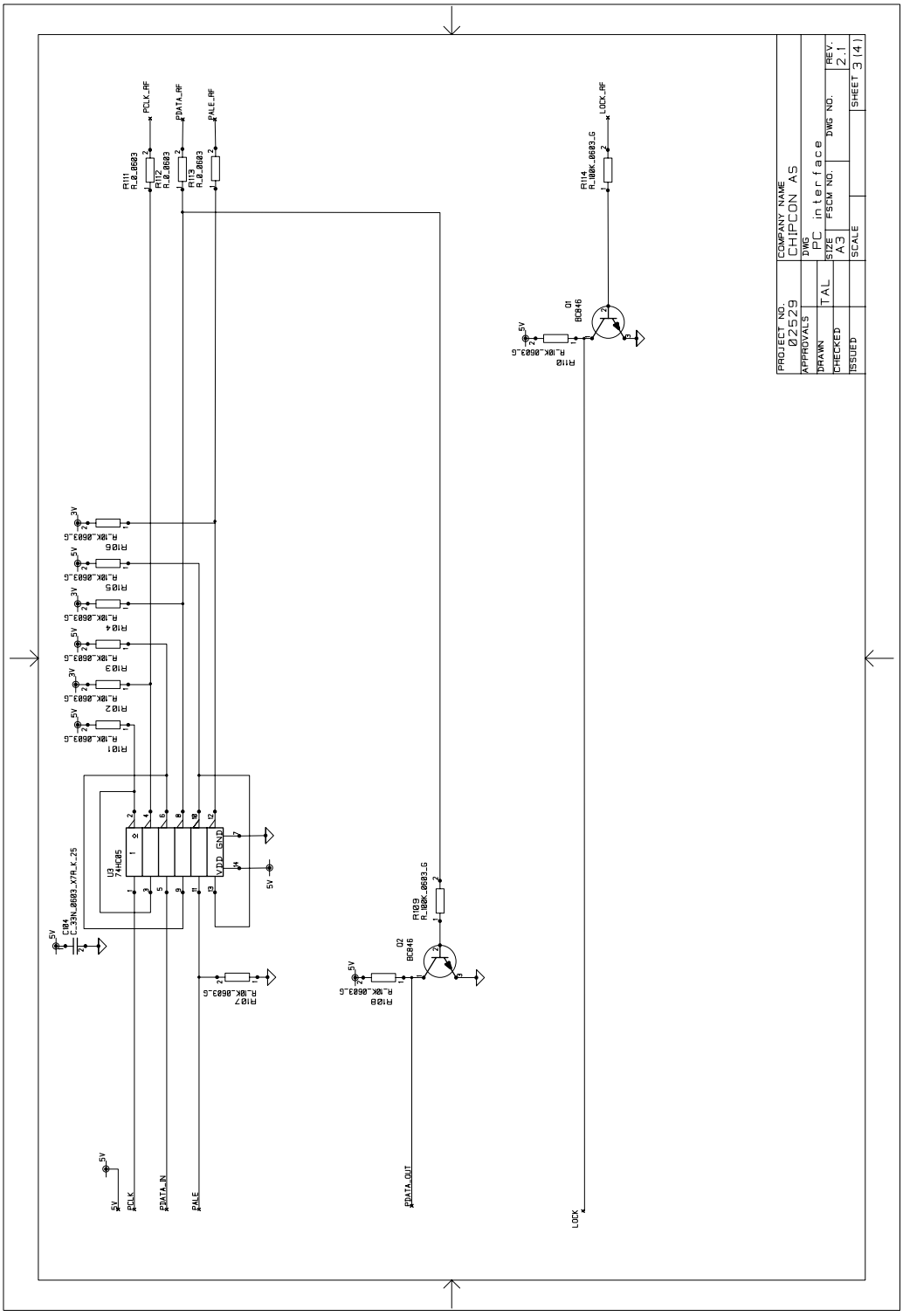
## Assembly drawing

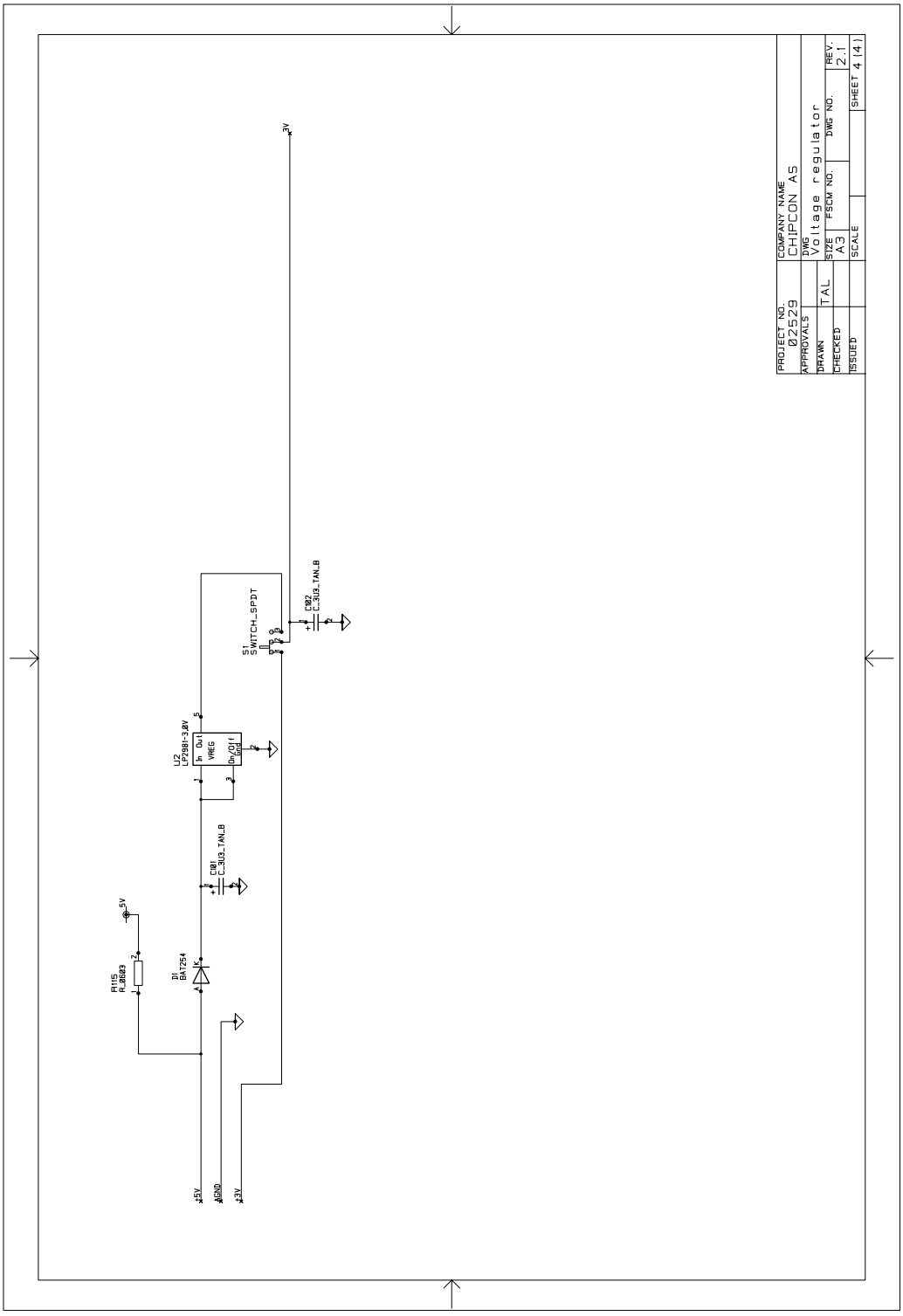


## Circuit diagram




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 |

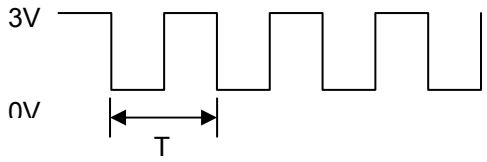
| Evaluation board | | | |
|---|---|---|---|
| *Reference* | *Description* | *Value* | *Part* |
| H1 | Circuit Board Support | | Distance 12.5mm |
| H2 | Circuit Board Support | | Distance 12.5mm |
| H3 | Circuit Board Support | | Distance 12.5mm |
| H4 | Circuit Board Support | | Distance 12.5mm |
| 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).

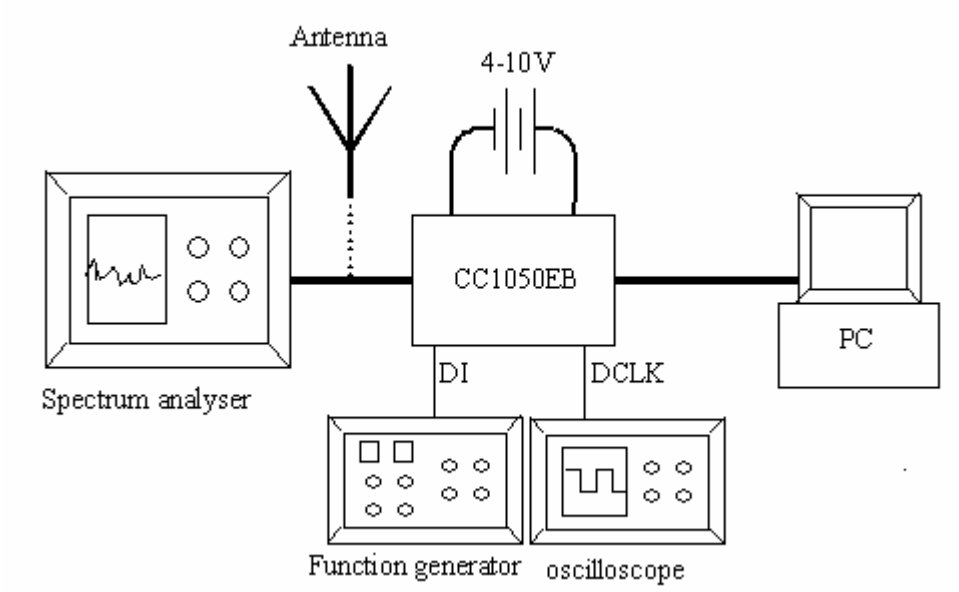



**Figure 2: Equipment set-up in transmit mode.**

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


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Живое партнерство

**ООО «ЛайфЭлектроникс»** **“LifeElectronics” LLC**

*ИНН 7805602321 КПП 780501001 Р/С 40702810122510004610 ФАКБ "АБСОЛЮТ БАНК" (ЗАО) в г.Санкт-Петербурге К/С 30101810900000000703 БИК 044030703*

*Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.*

*С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров*

*Мы предлагаем:*

- *Конкурентоспособные цены и скидки постоянным клиентам.*
- *Специальные условия для постоянных клиентов.*
- *Подбор аналогов.*
- *Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.*

- *Приемлемые сроки поставки, возможна ускоренная поставка.*
- *Доставку товара в любую точку России и стран СНГ.*
- *Комплексную поставку.*
- *Работу по проектам и поставку образцов.*
- *Формирование склада под заказчика.*

- *Сертификаты соответствия на поставляемую продукцию (по желанию клиента).*
- *Тестирование поставляемой продукции.*
- *Поставку компонентов, требующих военную и космическую приемку.*
- *Входной контроль качества.*
- *Наличие сертификата ISO.*

*В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.*

*Конструкторский отдел помогает осуществить:*

- *Регистрацию проекта у производителя компонентов.*
- *Техническую поддержку проекта.*
- *Защиту от снятия компонента с производства.*
- *Оценку стоимости проекта по компонентам.*
- *Изготовление тестовой платы монтаж и пусконаладочные работы.*

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***www.lifeelectronics.ru***