CLIL

Rolls Battery engineering

Manual

Rolls Battery has been manufacturing deep cycle lead-acid batteries since 1935. Experience gained has helped us achieve an unmatched reputation along with specific measures to obtain the maximum performance and life from our product. This manual describes the recommended charging, equalization and preventive maintenance procedures for Rolls batteries in order to maximize battery life.

Equipment needed

- Goggles, rubber gloves and rubber boots
- Distilled water
- Baking soda
- Voltmeter
- Hydrometer
- Battery charger

Safe Handling Procedure

Always wear acid-resistant clothing, PVC gloves, goggles and rubber boots – especially where there is risk of splashing. Always keep the batteries in an upright position. Always have plenty of water available in case of acid spillage.

Inspection

Upon arrival, check the battery for visible damage (i.e. cracks, dents, deformation and other visible abnormalities). Verify connections, assure that they are clean. If the battery is dirty, or if any minor amount of acid has spilled onto the case, check cleaning section of this manual. Any fluid on or around the battery could indicate damage or improperly sealed case. Please verify the polarity of the terminals. In the event of leak or damage please contact your retailer or Rolls Battery Company Limited to determine if the battery needs replacement.

Installation

Rolls offers batteries for a wide variety of applications. No matter the application, always be certain that the battery is properly secured, free of contaminants and that all connections are in good contact with the terminals. Contact your retailer or refer to Rolls Battery Technical Support.

Battery orientation

Flooded lead acid batteries must be kept in an upright position at all times. Electrolyte in the battery will spill if tilted.

Cable sizing

The size of the cables used should be proportionate to the amount of amperage in your system. See Table 1 for maximum current carrying capacity based on cable gauge.

Wire gauge size[1]	Amperage
14 (1,6 mm; 2,1 mm^2)	25
12 (2,0 mm; 3,3 mm^2)	30
10 (2,6 mm; 5,3 mm^2)	40
8 (3,3 mm; 8,3 mm^2)	55
6 (4,1 mm; 13,3 mm^2)	75
4 (5,2 mm; 21,2 mm^2)	95
2 (6,5 mm; 33,6 mm^2)	130
1 (7,3 mm; 42,4 mm^2)	150
00 (9,4 mm; 67,4 mm^2)	195
0000 (11,7 mm; 107 mm^2)	260

table 1 Wire gauge size

1 La dimensione dei cavi è espressa in notazione americana AWG. In parentesi sono riportati, per maggior chiarezza, gli equivalenti in diametro (mm) e sezione (mm^2).

Flooded Lead Acid Terminals

Terminal connections should be tightened to 25 ft · lbs[2] or 33 Nm for all terminals (table 2).

AGM Terminals	Torque Nm
Button Terminal (M8)	9.6-10.7
Button Terminal (M10)	12.2-14
AP	5.6-7.9
LT	9.6-10.7
DT (AP and stud terminal)	5.6-7.9
M6 (TP08)	3.9-5.4
M8 (TP08)	9.6-10.7

table 2 AGM Terminals

2 ft · lbs indica il corrispettivo in inglese dei Nm. Un piede (ft) equivale a 0,3 m, mentre 1 libbra (lbs) a 454 g.

Parallel/Series Connections

Certain applications demand more voltage or more capacity than one battery's output.
By arranging the connection configuration, one is able to increase the output voltage, output capacity or both if needed.

To increase voltage, connect the batteries in series as shown in Figure 1.

Example:
Battery Voltage = 6 V each
Battery Capacity = 400 AH each
System Voltage = 12 V
System Capacity = 400 AH

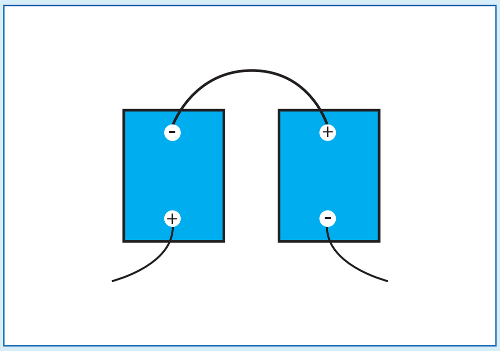

Figure 1 Voltage increase

To increase capacity, connect the batteries in parallel as shown in Figure 2.

Example:
Battery Voltage = 6 V each
Battery Capacity = 400 AH each
System Voltage = 6 V
System Capacity = 800 AH

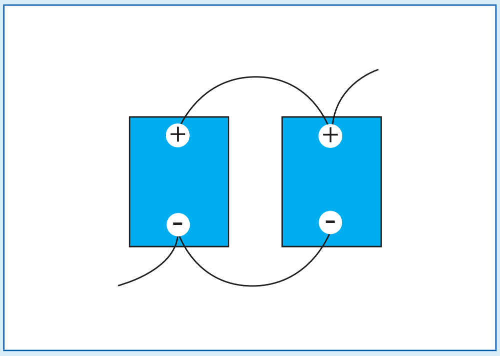

Figure 2 Capacity increase

To increase capacity and voltage, connect the batteries in series parallel as shown in Figure 3.

Example:
Battery Voltage = 6 V each
Battery Capacity = 400 AH each
System Voltage = 12 V
System Capacity = 800 AH

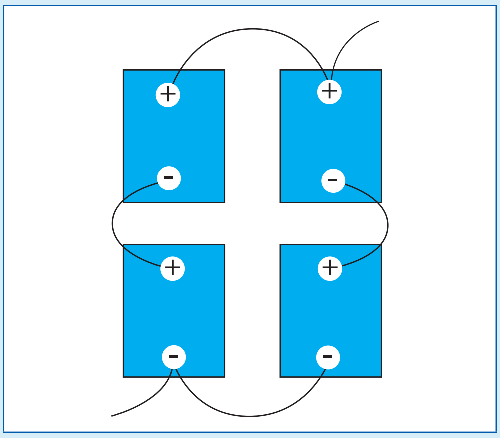

Figure 3 Voltage/Capacity increase

Example:
Twenty four (24) 2 V 2YS31P models at 2430 AH each = 2430AH at 48 V.

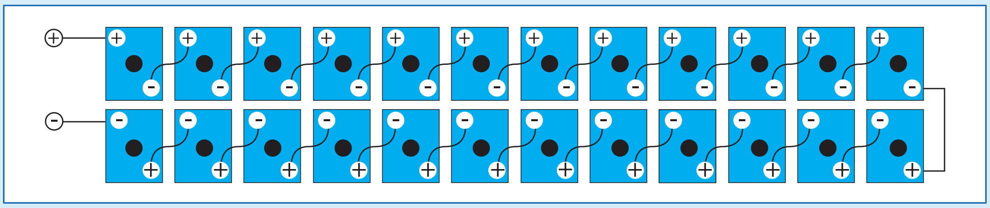

Figure 4 Single series string “Best Setup”

Example:
Two (2) strings of eight (8) 6 V S-530 models at 400 AH each = 2 × 400 AH at 48 V = 800 AH at 48 V.

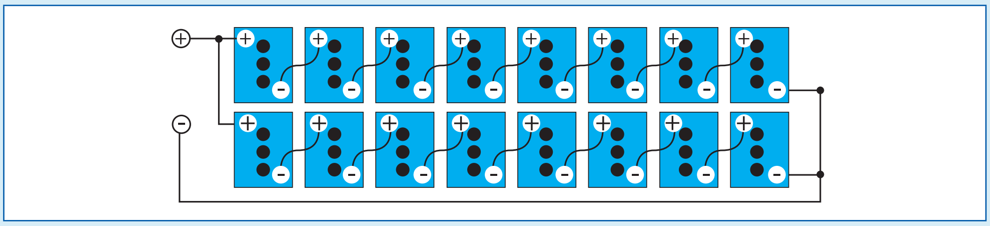

Figure 5 Two series strings

Example:
Three (3) strings of four (4) 12 V 12CS11P models at 357 AH each = 3 × 357 AH at 48 V = 1071 AH at 48 V.

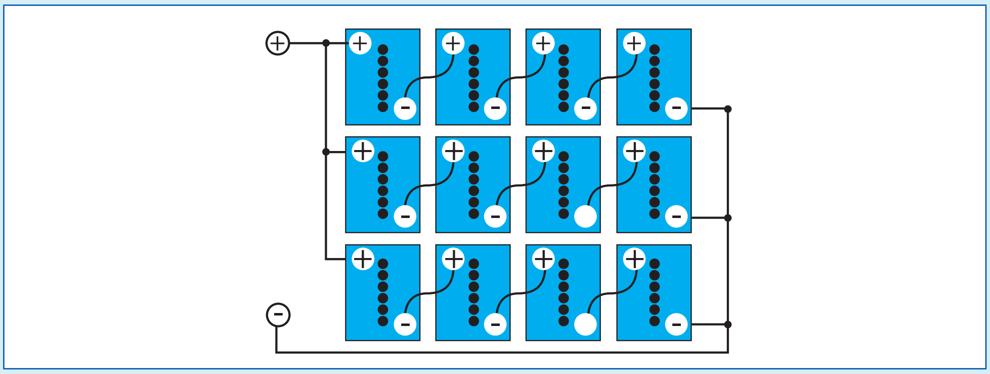

Figure 6 Three series strings

Note: we do not recommend more than three (3) series strings. Multiple parallel connection create unequal string resistances, resulting in possible cell damage or failure.

(adatt. da *Battery User Manual - Rolls Battery Engineering*)

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AC UPS Systems

TOPOLOGIES

Technology Overview

An uninterruptible power supply is designed to provide a battery-based source of AC power, such that under mains fail conditions the load can be supported for a specified period of time. This time is generally dictated by the period required to shut down equipment in an orderly fashion to allow for generator-starting time or for an engineer to attend site. In a high percentage of cases utility failure is for less than five minutes – consequentiy most standard UPS without external battery packs support the load for between five and ten minutes. This period is often only a bridge between mains fail and generator starting.

Basic Description and Operation

Online: 700VA to 800kVA single and three-phase input and output versions

Under normal conditions, mains is fed into the rectifier, which provides both DC power to the inverter and DC to charge the batteries. The inverter then feeds the load continuously. If mains fails, then the UPS continues to supply the load via the inverter but the inverter is now fed its power from batteries rather than from the rectifier. The load therefore sees no change during transfer from mains to inverter or vice versa. The static switch or auto-bypass provides a fail-safe mechanism in UPS fault conditions of the inverter, rectifier or battery. This type of UPS provides a true sine wave output under all circumstances and in the order of 60÷90 decibels of noise attenuation.

This topology offers the advantage of having its run time (autonomy) extended by adding additional battery modules. This is generally not true of offline or line interactive UPS as their inverters are not designed to run for extended periods of time.

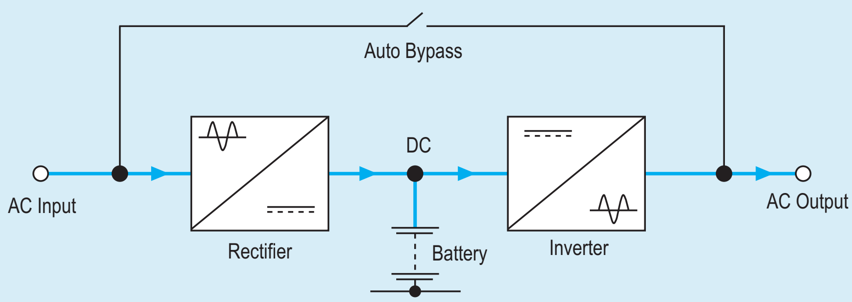

Figure 1 The blue arrows show normal operation (mains available)

Line Interactive:
400VA to 5kVA single phase only

During normal operation, mains po- wer is supplied to the load via a buck/bo- ost circuit in the UPS and the batteries are float-charged simultaneously. The- r e is a switch over time of 2÷10 m s between inverter and utility or vice versa. There is a small amount of line conditioning. Input to output noise attenuation is 20÷30 decibels.

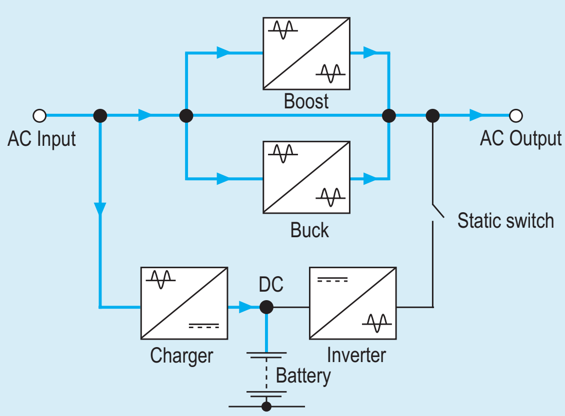

Figure 2 The blue arrows show normal operation (mains available)

Offline: 250VA to 800VA single phase only

During normal operation, mains is fed directly to the load and the batteries are float-charged. When a power failure occurs there is a small switch time to inverter of 2÷10 ms. The load is then supported by battery via the inverter. Typically the inverter is low cost and has a quasi-sine wave output. There is a very small amount of line conditioning and input to output noise attenuation is typically 5 decibels.
Offline UPS units are not suitable for supporting a critical load. The user is reliant on the inverter switching on when it is needed most, which means that a failure could occur at the most critical moment when mains fails. In these applications only online UPS units should be used.
In addition, most offline units are unsuitable for magnetic loads such as transformers, motors or linear power supplies. The quasi-sine wave can saturate the input magnetics of these devices causing damage.

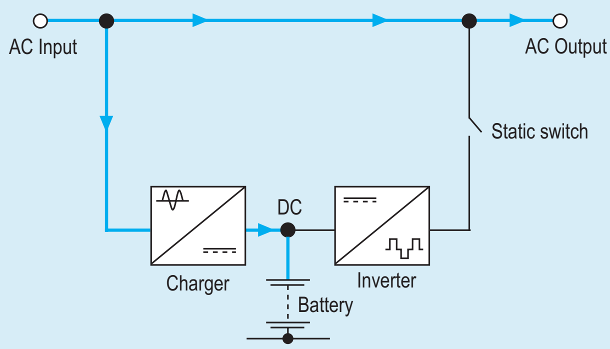

Figure 3 The blue arrows show normal operation (mains available)

Block description

Charger/Rectifier

This module converts AC (Utility/Mains) power to DC power. This DC then charges the battery and, in the case of an online UPS, also provides DC power to the input of the inverter.

Battery

The battery in any UPS system is the energy storage device. It provides DC power to the inverter under mains fail conditions.

Inverter

This module converts DC from the battery to AC, which supplies the load. It can be quasi sine wave (square wave output) for lower cost units like offline or line interactive (low end models) and sine wave for high end line interactive or online models.

Static Switch/Auto Bypass

This is an intelligent switch which looks at both mains input and inverter output, switching automatically between them depending on which source of power is available (utility or inverter). It also provides an overload route if the inverter in an online UPS is asked to provide more power than it can deliver. The bypass protects the load against inverter failure or rectifier failure.
The control or power module houses the charger, bypass switch and inverter. On smaller UPS below 3 kVA the batteries are also housed within the same chassis.

Advantages/Disadvantages of Different UPS Topologies

Offline UPS

Advantages	Disadvantages
• Very high efficiency • Low cost • Small size	• No line conditioning • Inverter off until needed most • No AC regulation • Minimal run time • Inverter quasi-sine wave • Very few options available • Software functions are basic 2÷10 ms break to/from inverter

Line Interactive UPS

Advantages	Disadvantages
• High efficiency • Lower cost than online • Provides AC regulation • Software and control are more comprehensive than offline • Full function display	• Very little line conditioning • Can be quasi-sine at low powers • Inverter off until needed most 2 ÷ 10 ms break to/from inverter

Online UPS

Advantages	Disadvantages
• Very good line conditioning • Inverter always on • Fail safe technology (bypass) • Full function UPS control • Multiple options cards • Extended autonomy solutions • Maintenance bypass options • Designed for critical load support	• Larger physical size • Higher costs • Less efficient than offline / line interactive

ACCESSORIES

UPS options and accessory products

- Accessory products for UPS tend to be available only for online models because of cost implications. They include: 19”[1] rack kits providing racking guides or shelves for 19” cabinet mounting of UPS and battery modules.
- Option cards for mounting within UPS. Option slots include:
  – volt-free or dry contact cards for contact closure remote advice of mains fail, battery low, bypass or UPS alarm;
  – USB cards to replace older style RS 232 connection for modern windows operating systems such as Windows XP.
- SNMP/network adapters allow UPS units to be accessed via the network. Network managers can also ensure that UPS units advise them of any power problems using SNMP communications protocol.
- Extended battery packs/modules allow run time or autonomy to be increased for up to 8 hours. Typical extended support times tend to be one hour or less.
- Maintenance bypass units are added to online UPS systems to ensure that under fault conditions the UPS can be taken out of circuit for repair/replacement. It is recommended that all online systems have a maintenance bypass unit.

(tratto da *XP - Power Supply Technical Guide*)

1 Le misure seguite da doppio apice (“) si intendono in pollici (1 pollice = 2,54 cm).

CLIL

Analog devices - Millivolt and voltage input

Product overview

The 5B Series represents an innovative generation of low cost, high performance plug-in signal conditioners. Designed for industrial applications, these modules incorporate highly reliable transformer-based isolation and automated surfacemount manufacturing technology. They are compact, economical components whose performance exceeds that available from more expensive devices. Combining 1500 V rms continuous isolation, +0.05% calibrated accuracy, small size and low cost, the 5B Series is an attractive alternative to expensive signal conditioners and in-house designs.
All modules are potted and identical in pin-out and size (2.27” × 2.32” × 0.595”)[1]. They can be mixed and matched, permitting users to address their exact needs, and may be hot swapped without disturbing field wiring or power. The isolated input modules provide 0 to +5 V or +5 V outputs and accept J, K, T, E, R, S, N, or B type thermocouples.
These modules feature complete signal conditioning functions including 240 V rms input protection, filtering, chopper stabilized low drift +1 uV/°C amplification, 1500 V rms isolation, and sensor excitation when required.
All modules feature excellent common mode rejection and meet industrial transient surge withstand specifications.

Functional Block Diagram

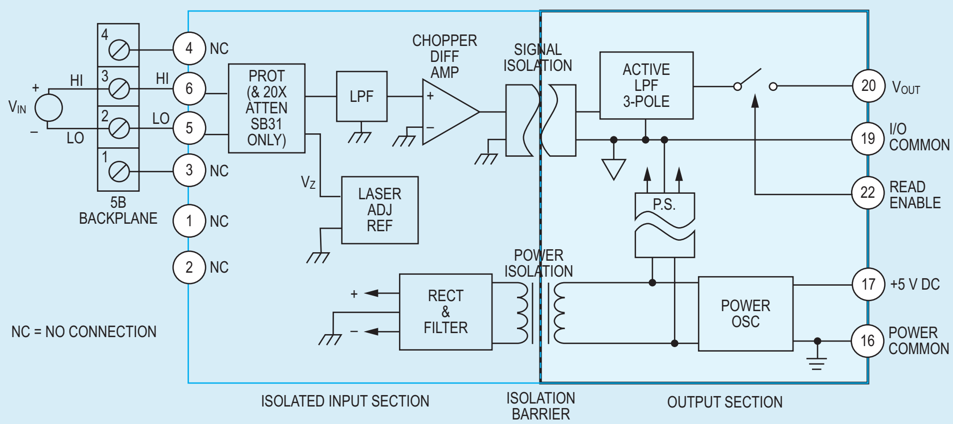

Figure 1 5B30/5B31 Functional Block Diagram

There are also a number of backplanes and mounting sockets which provide a complete signal conditioning solution for end users. Each backplane incorporates screw terminals for field wiring inputs and outputs and cold junction sensors for thermocouple applications.
These signal conditioners are designed to provide an easy and convenient solution to signal conditioning problems of both designers and end users in measurement and control applications. Typical uses include microcomputer-based measurement systems, standard data acquisition systems, programmable controllers, analog recorders and dedicated control systems. The 5 B series modules are ideally suited to applications where monitoring and control of temperature, pressure, flow, rotation and other analog signals are required. The 5B Series modules and backplanes are approved by Factory Mutual (FM) and the 5B Series modules are

1 Le misure seguite da doppio apice (“) si intendono in pollici (1 pollice = 2,54 cm).

approved by the Canadian Standards Association (CSA) for use in Class 1, Division 2, Groups A, B, C, and D locations. These approvals certify that the 5B Series is suitable for use in locations where a hazardous concentration of flammable gas may exist only under fault conditions of operation. Equipment of this category is called “non-incendive” and they need no special enclosures or other physical safeguards.
The 5B series modules and backplanes have been tested and passed the stringent heavy industrial requirements of the European Union’s electromagnetic compatibility (ENC) directive – EN50082-1 and EN50081-2. When used according to installation directions (refer to 5B series User Manual), any errors caused by EMI/RFI interference will be less than 0.1% of the full scale 5B measurement range for field strengths up to 10 V/m and frequencies up to 1 GHz.

General description

The 5B30 and 5B31 are single-channel signal conditioning modules that amplify, protect, filter and isolate analog input voltages. The 5B30 and 5B31 protect the computer side from damage due to field-side over voltage faults. All models withstand 240 V rms at their input terminals without damage thereby shielding computer side circuitry from field-side over voltage conditions.
In addition, 5B30 and 5B31 Series modules are mix-and-match and hot swappable, so can be inserted or removed from any socket in the same backplane without disrupting system power.
A chopper-stabilized input amplifier provides low drift and stable gain. At the amplifier input, a stable, laser-trimmed zeroscale input voltage is subtracted from the input signal to set the zero scale value. For user convenience, the zero can be optionally factory-set to meet custom needs. This allows suppression of a zero-scale input value many times larger that the total span for precise expanded-scale measurements. Internal multi-pole low-pass filtering with a four-Hz cutoff (–3 dB) enhances normal-mode (noise on signal) and common-mode (nosie on signal return) rejection at 50/60 Hz, enabling accurate measurement of small signals in high electrical noise.
Signal isolation by transformer coupling uses a proprietary modulation technique for linear, stable and reliable performance. The differential input circuit on the field side is fully floating, eliminating the need for any input grounding. A demodulator on the computer side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a low-noise, low-impedance output signal. The output common must be kept within ±3 V of power common.
A series output switch eliminates the need for external multiplexing in many applications. The switch is turned on by an active-low enable input. If the switch is to be on at all times, the enable-input should be grounded to power common as it is on the 5B01 and 5B08 backplanes.

(tratto da *Analog Devices - Millivolt and voltage input, www.analog.com*)

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CC1101 Low-Power Sub-1 GHz RF Transceiver

CC1101 is a low-cost sub-1 GHz transceiver designed for very low-power wireless applications.
The circuit is mainly intended for the ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency bands at 315, 433, 868, and 915 MHz, but can easily be programmed for operation at other frequencies in the 300–348 MHz, 387–464 MHz and 779–928 MHz bands.
The RF transceiver is integrated with a highly configurable baseband modem. The modem supports various modulation formats and has a configurable data rate up to 600 kbps.
CC1101 provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication, and wake-on-radio.
The main operating parameters and the 64-byte transmit/receive FIFOs of CC1101 can be controlled via an SPI interface. In a typical system, the CC1101 will be used together with a microcontroller and a few additional passive components.

Circuit Description

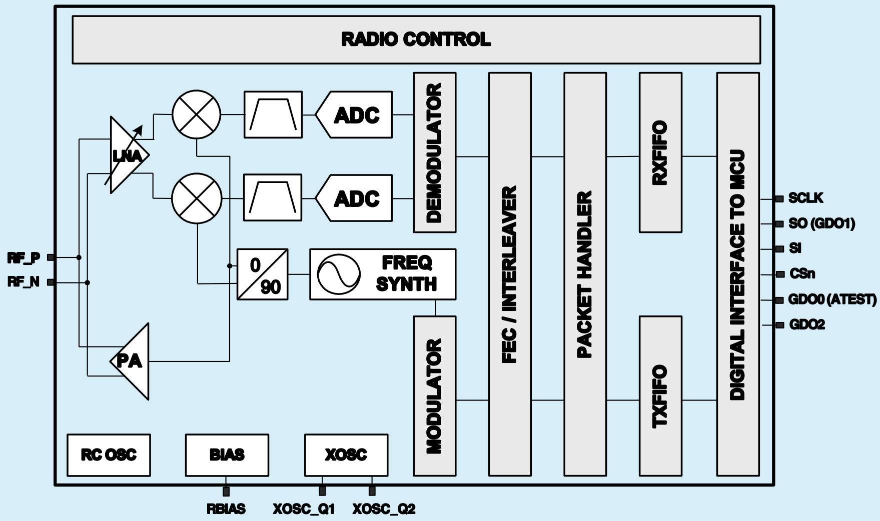


Figure 1 *CC1101 Simplified Block Diagram*.

A simplified block diagram of CC1101 is shown in **Figure 1**. CC1101 features a low-IF receiver. The received RF signal is amplified by the low-noise amplifier (LNA) and down-converted in quadrature (I and Q) to the intermediate frequency (IF). At IF, the I/Q signals are digitised by the ADCs. Automatic Gain Control (AGC), fine channel filtering, demodulation, and bit/packet synchronization are performed digitally.
The transmitter part of CC1101 is based on direct synthesis of the RF frequency. The frequency synthesizer includes a completely on-chip LC VCO and a 90 degree phase shifter for generating the I and Q LO signals to the down-conversion mixers in receive mode. A crystal is to be connected to XOSC_Q1 and XOSC_Q2. The crystal oscillator generates the reference frequency for the synthesizer, as well as clocks for the ADC and the digital part. A 4-wire SPI serial interface is used for configuration and data buffer access.
The digital baseband includes support for channel configuration, packet handling, and data buffering.

Application Circuit

The 315 MHz and 433 MHz CC1101EM design use inexpensive multilayer inductors. The 868 MHz and 915 MHzCC1101EM design use wirewound inductors as this give better output power, sensitivity, and attenuation of harmonics compared to using multi-layer inductors. The output power is then typically +10 dBm when operating at 868/915 MHz.

Bias resistor

The bias resistor R171 is used to set an accurate bias current.

Balun and RF Matching

The balanced RF input and output of CC1101 share two common pins and are designed for a simple, low-cost matching and balun network on the printed circuit board. The receive and transmit switching at the CC1101 front-end is controlled by a dedicated on-chip function, eliminating the need for an external RX/TXswitch. A few external passive components combined with the internal RX/TX switch/termination circuitry ensures match in both RX and TX mode. The components between the RF_N/RF_P pins and the point where the two signals are joined together (L121, L131, C121, L122, C131, C122 and L132 for the 868/915 MHz design) form a balun that converts the differential RF signal on CC1101 to a single-ended RF signal. C124 is needed for DC blocking. Together with an appropriate LC network, the balun components also transform the impedance to match a 50 Ω load. C125 provides DC blocking and is only needed if there is a DC path in the antenna. For the 868/915 MHz design, this component may also be used for additional filtering.

Crystal

A crystal in the frequency range 26-27 MHz must be connected between the XOSC_Q1 and XOSC_Q2 pins. The oscillator is designed for parallel mode operation of the crystal. In addition, loading capacitors (C81 and C101) for the crystal are required. The loading capacitor values depend on the total load capacitance, CL, specified for the crystal. The total load capacitance seen between the crystal terminals should equal CL for the crystal to oscillate at the specified frequency.

The parasitic capacitance is constituted by pin input capacitance and PCB stray capacitance.
Total parasitic capacitance is typically 2.5 pF. The crystal oscillator is amplitude regulated.
This means that a high current is used to start up the oscillations. When the amplitude builds up, the current is reduced to what is necessary to maintain approximately 0.4 Vpp sign swing. This ensures a fast start-up, and keeps the drive level to a minimum. The ESR of the crystal should be within the specification in order to ensure a reliable start-up.
The initial tolerance, temperature drift, aging and load pulling should be carefully specified in order to meet the required frequency accuracy in a certain application.
Avoid routing digital signals with sharp edges close to XOSC_Q1 PCB track or underneath the crystal Q1 pad as this may shift the crystal dc operating point and result in duty cycle variation.
For compliance with modulation bandwidth requirements under EN 300 220 in the 863 to 870 MHz frequency range it is recommended to use a 26 MHz crystal for frequencies below 869 MHz and a 27 MHz crystal for frequencies above 869 MHz.

Reference signal

The chip can alternatively be operated with a reference signal from 26 to 27 MHz instead of a crystal. This input clock can either be a fullswing digital signal (0 V to VDD) or a sine wave of maximum 1 V peak-peak amplitude. The reference signal must be connected to the XOSC_Q1 input. The sine wave must be connected to XOSC_Q1 using a serial capacitor. When using a full-swing digital signal, this capacitor can be omitted. The XOSC_Q2 line must be left un-connected. C81 and C101 can be omitted when using a reference signal.

Additional Filtering

In the 868/915 MHz design, C126 and L125 together with C125 build an optional filter to reduce emission at carrier frequency –169 MHz. This filter is necessary for applications with an external antenna connector that seek compliance with ETSI EN 300-220. For more information, see DN017 If this filtering is not necessary, C125 will work as a DC block (only necessary if there is a DC path in the antenna). C126 and L125 should in that case be left unmounted. Additional external components (e.g. an RF SAW filter) may be used in order to improve the performance in specific applications.

Power Supply Decoupling

The power supply must be properly decoupled close to the supply pins. Note that decoupling capacitors are not shown in the application circuit. The placement and the size of the decoupling capacitors are very important to achieve the optimum performance.

Component	Description
C81/C101	Crystal loading capacitors
C121/C131	RF balun/matching capacitors
C122	RF LC filter/matching filter capacitor (315/433 MHz). RF balun/matching capacitor (868/915 MHz)
C123	RF LC filter/matching capacitor
C124	RF balun DC blocking capacitor
C125	RF LC filter DC blocking capacitor and part of optional RF LC filter (868/915 MHz)
C126	Part of optional RF LC filter and DC-block (868/915 MHz)
L121/L131	RF balun/matching inductors (inexpensive multi-layer type)
L122	RF LC filter/matching filter inductor (315 and 433 MHz). RF balun/matching inductor (868/915 MHz). (inexpensive multi-layer type)
L123	RF LC filter/matching filter inductor (inexpensive multi-layer type)
L124	RF LC filter/matching filter inductor (inexpensive multi-layer type)
L125	Optional RF LC filter/matching filter inductor (inexpensive multi-layer type) (868/915 MHz)
L132	RF balun/matching inductor. (inexpensive multi-layer type)
R171	Resistor for internal bias current reference
XTAL	26 – 27 MHz crystal

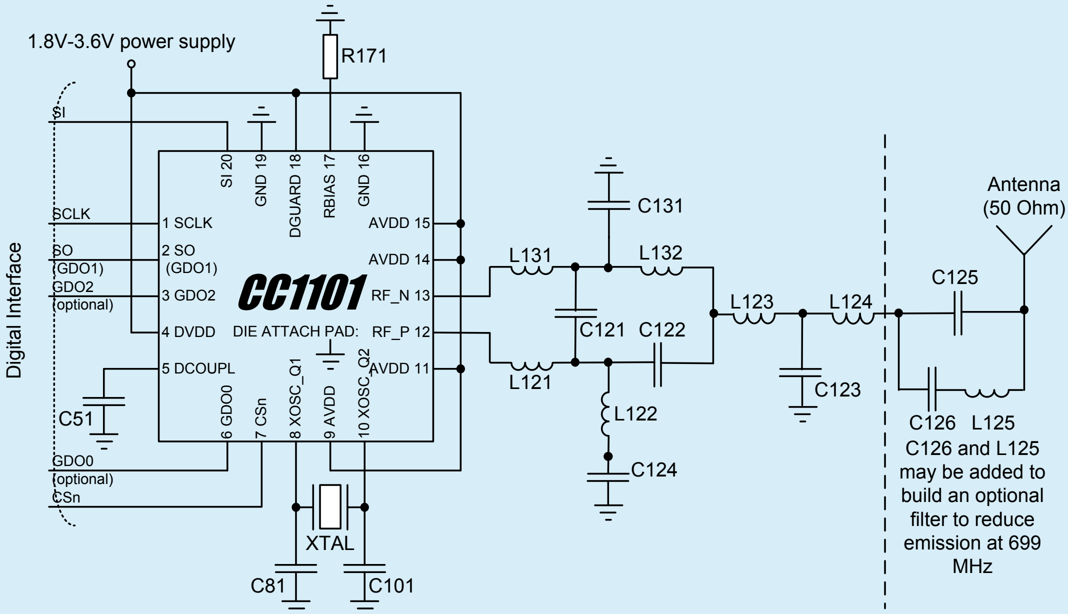


Figure 2 *Typical Application and Evaluation Circuit 868/915 MHz (excluding supply decoupling capacitors)*

(*adattato da Texas Instruments – CC1101 Low-Power Sub-1 GHz RF Transceiver*)

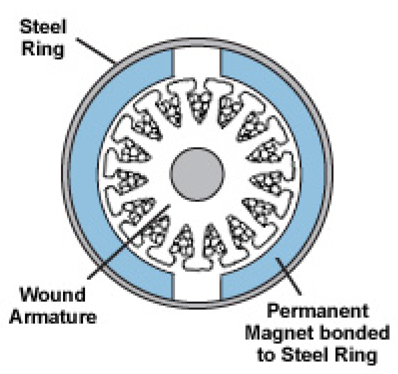
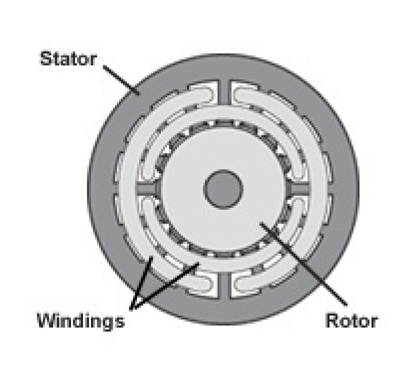
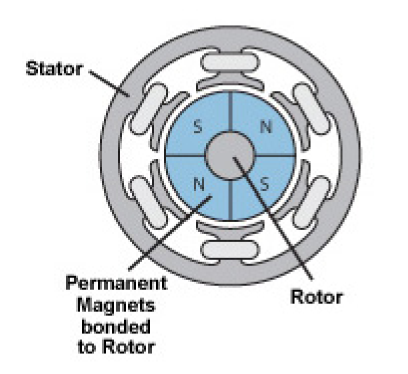
CLIL

Brushless DC Motor vs. AC Motor vs. Brushed Motor?

Brushless DC motors provide high power in a small package. Oriental Motor manufacturers a wide range of AC motor and brushless DC (BLDC) motor products. So why choose one technology over the other? There are several key differences between the different technologies.

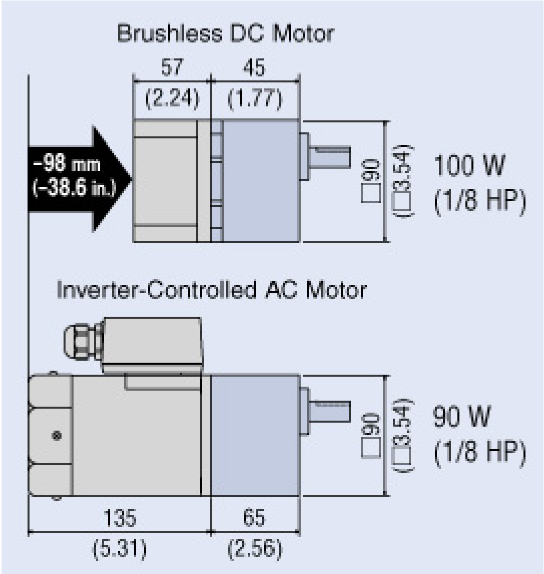
Motor Construction

Brushed DC motors depend on a mechanical system to transfer current, while AC and brushless DC gear motors use an electronic mechanism to control current. The brushed motors have a wound armature attached to the center with a permanent magnet bonded to a steel ring surrounding the rotor. As the brushes come into contact with the commutator the current passes through to the armature coils.
AC induction motors and BLDC motors do not depend upon the mechanical system (brushes) to control current. The AC and BLDC motors pass current through the stator (electromagnet) which is connected to AC power directly or via a solid-state circuit.
In AC induction motors the rotor turns in response to the "induction" of a rotating magnetic field within the stator, as the current passes. Rather than inducing the rotor in a brushless DC motor, permanent magnets are bonded directly to the rotor, as the current passes through the stator, the poles on the rotor rotate in relation to the electromagnetic poles created within the stator, creating motion.

Brushed Motor Construction	AC Motor Construction	Brushless Motor Construction
		

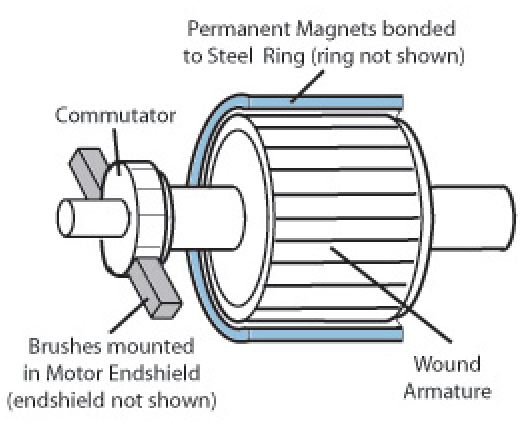
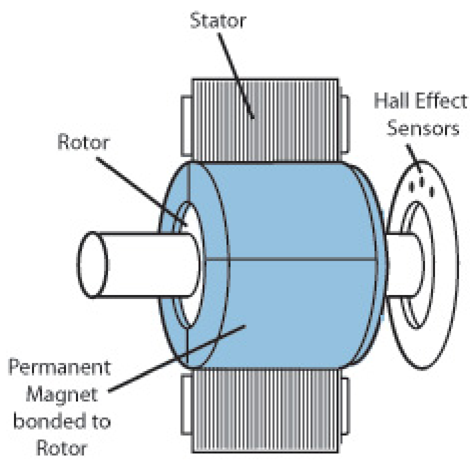
Efficiency

The efficiency of a system is defined as the amount of output received, as a percentage of what was input into the system. Therefore, when we talk about the energy efficiency of brushless DC (BLDC) motors, we are saying that we can obtain a relatively high amount of mechanical power, in return for the electrical power that we use.
All three technologies have power loss in the form of I-R losses. DC motors utilize permanent magnets so none of their energy needs to be used in the creation of an electromagnet as in AC motors. The energy used by AC motors to create the electromagnet decreases the efficiency of the AC motor in comparison to the DC motors.
At the same time, BLDC motors are considered more energy efficient than brushed DC-motors. This means for the same input power, a BLDC motor will convert more electrical power into mechanical power than a brushed motor, mostly due to absence of friction of brushes. The enhanced efficiency is greatest in the no-load and low-load region of the motor's performance curve.
A BLDC motor, for the same mechanical work output, will usually be smaller than a brushed DC motor, and always smaller than an AC induction motor. The BLDC motor is smaller because its body has less heat to dissipate. From that standpoint, BLDC motors use less raw material to build, and are better for the environment.



Service and Maintenance: DC vs. BLDC

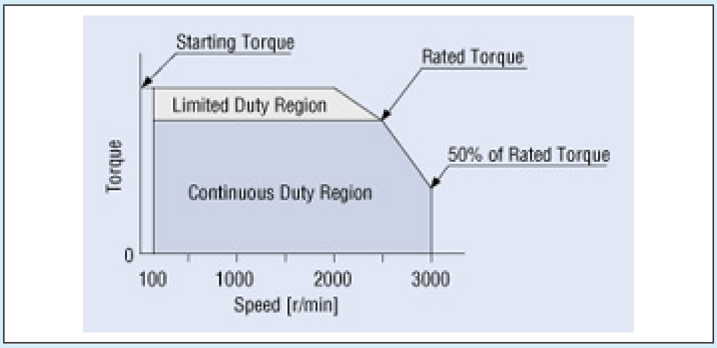
Brushed motors are not only larger than their brushless counterparts: they also have a shorter service life. The brushes in the brushed motor are usually made of carbon or graphite compounds which wear during use. These brushes will require maintenance and replacement over time, so the motor will need to be accessible to ensure continued service. As the brushes wear the not create dust but noise caused by the rubbing against the commutator. Brushless motors have longer service lives and are cleaner and quieter because they do not have parts the rub or wear during use.

Brushed DC Motor	Brushless DC Motor
	

Speed Stability

Hall-effect sensors built in the BLDC motor detect the change in polarity from an N pole to an S pole as the rotor is spinning. Based on the time between state changes, the rotor's speed is determined. This information is then fed to the drive circuit to adjust the speed of the switching sequence.

High Speed Operation



Brushed and brushless DC systems provide flat torque over a wide speed range while AC motors often lose torque as speed increases. Oriental Motor has several BLDC packages offering speed control ranges as low as 3 rpm to as high as 4,000 rpm.

(tratto da *Oriental Motor – www.orientalmotor.com/index*)