Bluetooth - BT1

Dokumente und Anleitungen zum Soartronic BT1

04.04.2013

Inhaltsverzeichnis

1. Einbindung des BT1 als Datenquelle für XCSoar

(Beispiel: Android 4.2.2; Bilder unter Windows 7 64bit mit Software: XCSoar 6.5)

Paaren der Geräte:

1. BT1 / FLARM einschalten
2. Bluetooth am Mobilgerät einschalten
3. Systemeinstellungen - Bluetooth
   a) Nach neuen Geräten suchen (Search for devices)
   b) BT1 unter vorkonfiguriertem Namen auswählen (Std: Flugzeugkennzeichen)
   c) Pin eingeben (Std: letzte 4 Ziffern/Buchstaben des Flugzeugkennzeichens)

Einstellen der Datenquelle in der genutzten Software:

1. Software (z.B. XCSoar) starten
2. Datenquellen konfigurieren
   a) Konfiguration (Config) - System - Einstellungen (Setup) - NMEA- Anschluß (Devices)

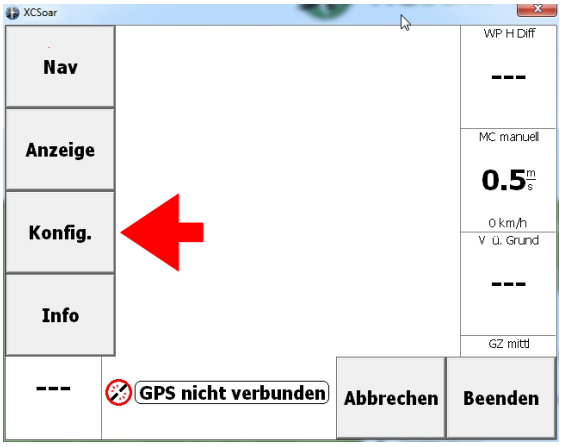


Abbildung 1.1: XCsoar: Konfiguration (Config)

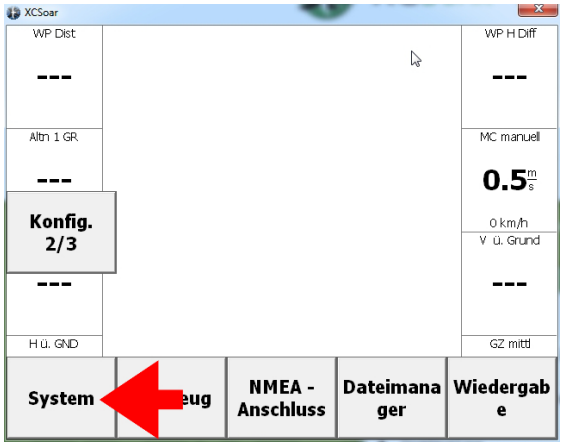


Abbildung 1.2: XCsoar: Konfiguration (Config) - System

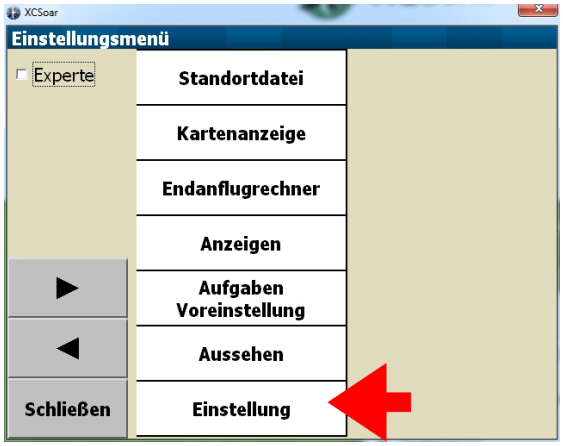


Abbildung 1.3: XCsoar: Konfiguration (Config) - System - Einstellungen (Setup)

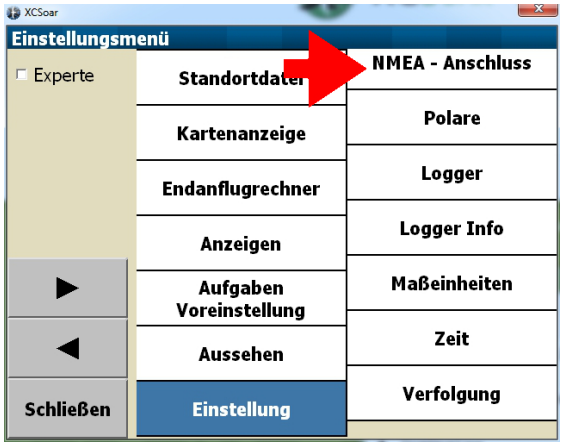


Abbildung 1.4: XCsoar: Konfiguration (Config) - System - Einstellungen - NMEA-Anschluss (Devices)

b) Gewünschte Datenquelle wählen

   i. Slot auswählen

   ii. Anschluss auswählen - wird angezeigt mit vorkonfiguriertem Namen

iii. Treiber auswählen - BT1 angeschlossen an Flarm, darum Treibername: FLARM

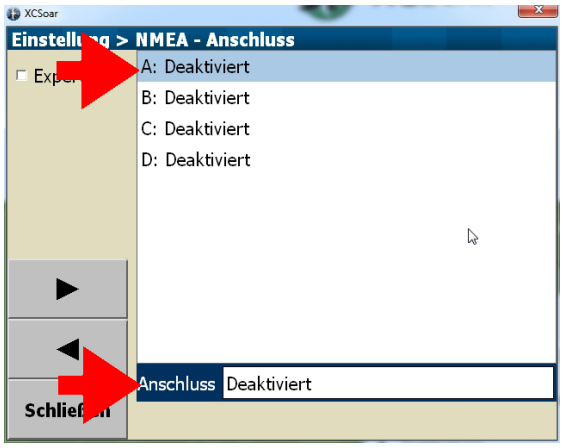


Abbildung 1.5: XCsoar: Slot / Source

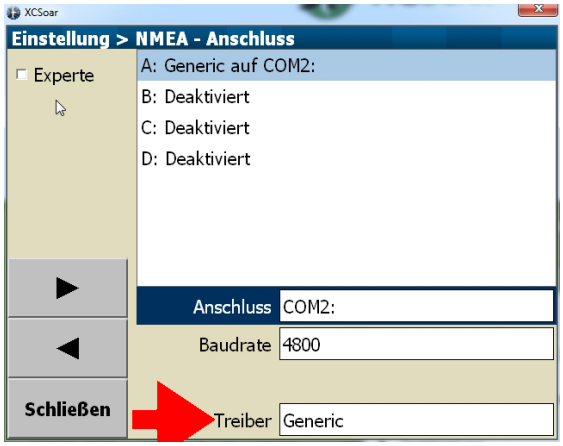


Abbildung 1.6: XCsoar: Treiber

2. Konfiguration Soartronic BT1

1. Soartronic BT1 an PC (RS232) und Flarm anschließen

   a) Hierbei wird die Stromversorgung an den + /– Pol am BT1 angeschlossen, dieses versorgt das Flarm über das angeschlossene Kabel (Konfigurationskabel) mit Strom (Wie im Flugzeug vorgesehen). Das an das BT1 angeschlossene Flarm liefert 3,3V an das BT1 zurück, welches zum Betrieb des BT1 verwendet wird. Im Gegensatz zum normalen Betrieb von Flarm und BT1 werden keine Daten vom Flarm benötigt, sondern müssen Daten zwischen dem BT1 und dem PC (RS232) ausgetauscht werden.

   Daher sind am Konfigurationskabel folgende Leitungen zu finden (s.h. A.1):

Leitungsname	Gerät 1	Gerät 2
3xGND	BT1	FLARM
2x12V +	BT1	FLARM
3,3V +	FLARM	BT1
GND	BT1	RS232
RX	BT1	RS232
TX	BT1	RS232

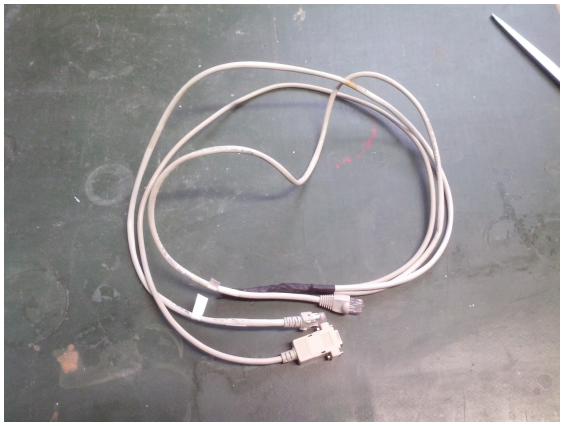


Abbildung 2.1: Konfigurationskabel

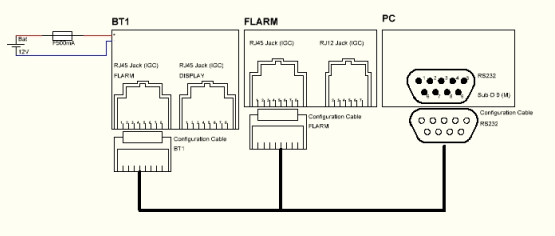


Abbildung 2.2: Konfigurationskabel - verbinden

2. Einschalten der Stromversorgung für das BT1/FLARM
3. Terminalprogramm aufrufen
   a) Terminalprogramm ist theoretisch frei wählbar, HT Comm hat jedoch als einziges ohne Anlaufschwierigkeiten funktioniert
   b) Auf Einstellungen für Kommunikation (Baudrate, Stopbits, Parität usw.) achten
   c) Std. Baudrate 19200
   d) Com Anschluss je nach PC unterschiedlich, kommt darauf an wo RS232 angeschlossen wurde
4. Mit BT1 verbinden (falls nicht automatisch)
5. BT1 mit AT-Kommandos gemäß Datasheet (s.h. A.4) konfigurieren
   a) Verwendeter Bluetoothchip auf BT1 ist „EGBT-046S“ Verwendeter RS232 Chip ist der „ST232CN“. Dokumentationen sind angehängt.
   b) Beispiel für Konfiguration:

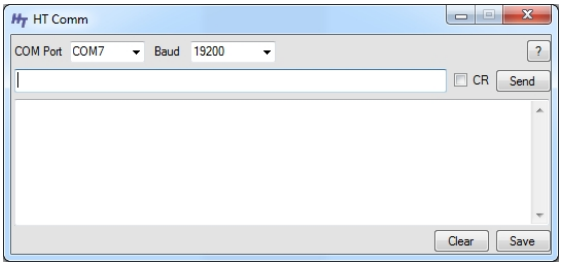


Abbildung 2.3: Terminalprogramm und BT1 mit richtigen Port (hier: Com7) und voreingestellter Baudrate (19200Bd) verbinden.

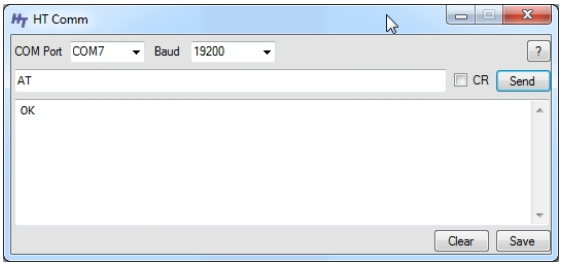


Abbildung 2.4: Mit Hilfe des Kommandos AT die Kommunikation zwischen BT1 und Terminalprogramm testen

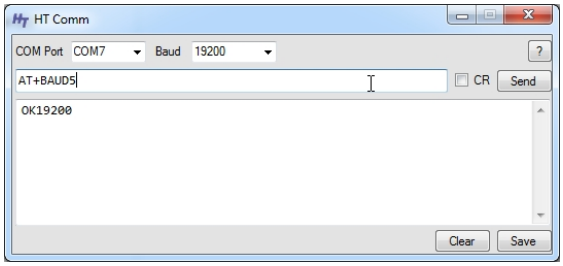


Abbildung 2.5: Baudrate erneut einstellen (falls erwünscht) auf 19200Bd mit Befehl: AT+BAUD5

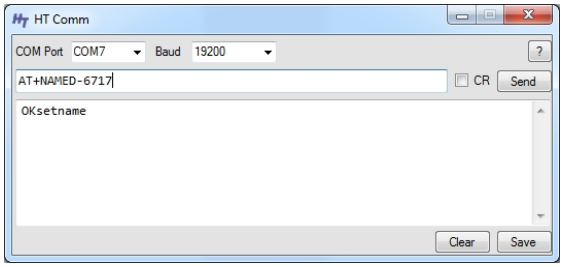


Abbildung 2.6: Anzeigename des BT1 einstellen (hier: Kennzeichen) mit Befehl: AT+NAMED-XXXX

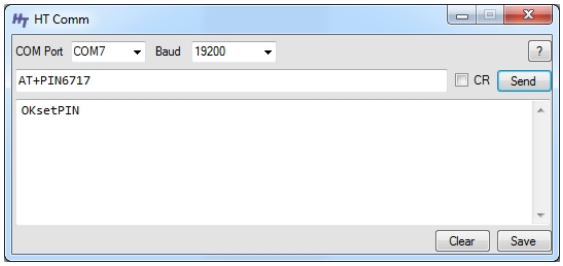
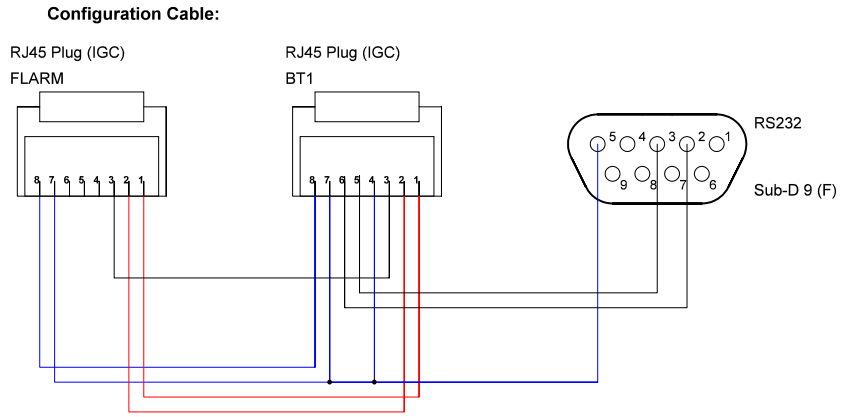


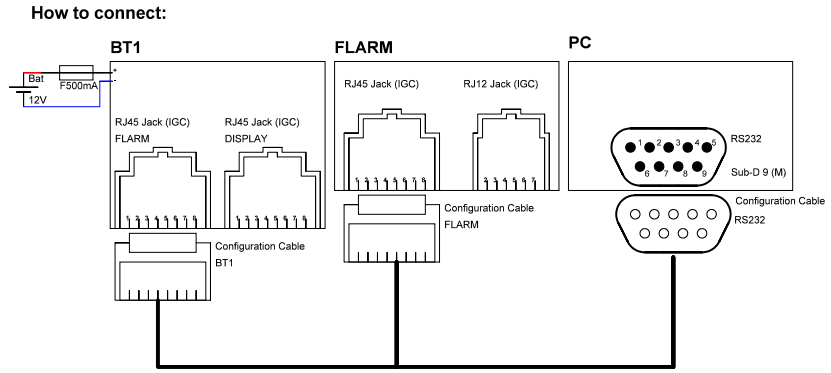
Abbildung 2.7: Pin des BT1 einstellen (hier: letzten 4 Ziffern des Kennzeichens) mit Befehl: AT+PINXXXX

6. Stromversorgung BT1/Flarm neu starten
7. Mit Handy o.ä. ausprobieren ob BT1 richtig konfiguriert ist (Name/Pin/Baudrate)
   a) Falls BT1 mit richtigen Namen gefunden wird und der Pin stimmt sollte alles stimmen. Mit Androidgeräten kann z.B. die Segelflugsoftware XCSoar heruntergeladen werden. Hier kann man dann das BT1 (entsprechende eingetellter Name) als Datenquelle einstellen, welches die Flarmdaten liefert (FLARM-Treiber einstellen!), bei bestehender Datenverbindung (normales Kabel zwischen BT1 und Flarm) zwischen Flarm und BT1 besteht dann die Möglichkeit das Flarm zu konfigurieren und man kann den NMEA Datenstrom anzeigen lassen.
8. Bei Erfolg Stromversorgung BT1 / Flarm trennen
9. Konfigurationskabel entfernen und normales CAT5 Kabel (Twisted pair; Kategorie 5; straight through) zur Datenübertragung anschließen

A. Appendix

A.1. Konfigurationskabel BT1



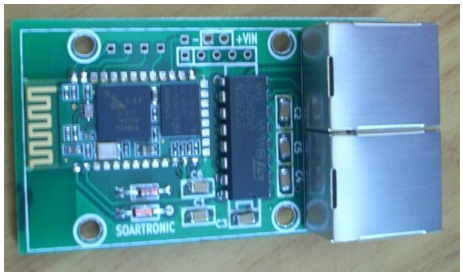


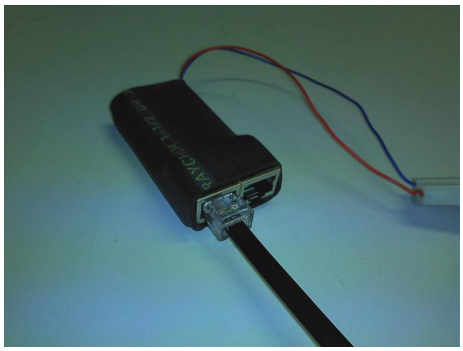
A.2. Soartronic BT1 Manual

SoarTronic Bluetooth BT1 v.1
Owners manual

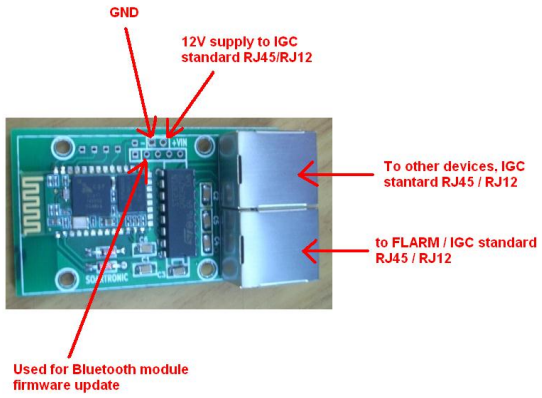
This manual includes information for users of
SoarTronic Bluetooth BT modules

Please note, that this device is a result of an experimental project
and no guarantee of safety or usability can be given.
This device is used on your own risk!





SoarTronic - Electronics for soaring



Picture 1. Connection points of the *SoarTronic Bluetooth BT1 V.1*

SoarTronic Bluetooth BT1

Device for connecting FLARM midair and obstacle collision warning system with any Bluetooth capable device over Bluetooth connection. Very simple installation - takes 3.3Voperating power from FLARM unit.

This device has two IGC standard RJ45 type ports, similar as used in Ethernet networks (Picture 1). One port is designed for connection with FLARM units. Another port is designed to connect with external display, variometer, or power supply (or any other device you need to connect with your FLARM unit). Please refer to FLARM manuals for detailed description of RJ ports and cabling.

The RJ ports can be connected with 8 wire RJ45 connector (found from original Swiss FLARM, for example) or with 6 wire RJ12 connector (found from LX Navigation LX FLARM units, for example). When RJ12 connector and cabling is used, the pins 1 a,d 8 or the RJ45 are unused. In IGC standard RJ45 pins 1 and 2 are connected, and also pins 7 and 8 and connected together.

Installation guide:

FLARM units can supply 3.3 V operating voltage for two external display units, which each draw about 45 mA. *SoarTronic Bluetooth BT1* draws under 40mA while pairing with another device, then about 20 mA when connected. Do not connect more than 90 mA load into the FLARM 3.3 mA supply. That is one External display and one *SoarTronic Bluetooth BT1.*
If you have any other device connected with your FLARM unit's RJ45 port, disconnect that cable from the other unit and connect it into *FLARM* port of the *SoarTronic Bluetooth BT1*. Then take IGC standard RJ45 or RJ12 cable and connect that between the free RJ port of *SoarTronic Bluetooth BT* and the other device.

Bluetooth setup

1. Open your PDA or other device and go to settings / Bluetooth / devices and start finding Bluetooth devices.

2. Start *SoarTronic Bluetooth BT1*, i.e. connect it with FLARM device that provides 3.3V to the Bluetooth. In original FLARM units use the 8 pin RJ45 connector – the other RJ12 (6 pin) is for external display only, operates on 4800 bauds (fixed) and does not transmit traffic information. In LX FLARM devices there is only one RJ12 (6 pin) connector. In LX RedBox FLARM please do not connect the device into SD card reader port.

3. When *SoarTronic Bluetooth BT1* powers up, you should see a new device appearing in the list of Bluetooth devices. Select it, and give the pairing PIN code when requested by your device.
Default pairing PIN code is 1234.

4. Now your setup is done, and your Bluetooth communication should be selectable in your list of devices.

5. In XCSoar devices go to Config / Config / System Setup / Setup / Devices and select device A, B, C or D. When you select one, you can then select the port you want. Your Bluetooth device name should now be found from your list. In some cases you might see your Bluetooth device number (for example 11:12:01:12:00:38). Select your device, and se tall other selections to off. Please note, that the GPS information used by XCSoar is selected in alphabetical order, and if your have several connected, you can here set the priority of usage.

In other devices/flight computer programs please refer to the manual for instructions.

You might need to wait up to one minute until XCSoar gets the Bluetooth device connected.

12V supply

SoarTronic Bluetooth BT1 has *Vin* input for 12V and ground (GND) (Picture 1). These connection points are directly connected with IGC standard RJ45 connectors pins 1,2 and 7,8, or if RJ12 connector is used, into pins 1 and 6. This 12V is NOT used by *SoarTronic Bluetooth*. Please make sure, that you do not have 12V supplied into the RJ cables from other devices, and that this 12V is not from other potential!

Connecting two RS232 lines into FLARM RX line

Many splitter units used to connect FLARM devices with PDA and display unit has a Declare/Display switch build-in. This switch is needed, because two devices sending RS232 information cannot normally be connected parallel into one RS232 line. *SoarTronic Bluetooth BT1* has build-in electronics, that makes it possible to declare (and download logger files) from FLARM unit without disconnecting display. However, it is not possible to send data from two devices simultaneously. This does not cause problems in normal use, since operating display units is not normally needed during declaration or file download.

Technical data:

Power supply:	3.3 V (3.0 – 3.6 V)
Power consumption	<40mA / 3.3 V
RS232 communication speed	19200 bauds (adjustable using AT commands)
Bluetooth type	Class 2.0 / 10 meters range
Bluetooth device name	User defines OR SoarTronic_BT1 (standard units)
Bluetooth pairing PIN	User defined OR serial number (standard units)

SoarTronic Bluetooth BT is set up for 19200 baud communication speed. The communication speed can be changed, however it is not easy to setup the programming connection. There is also a risk of locking to module, and therefore baud-rate setting is not explained in this manual. Also the Bluetooth module firmware can be updated.

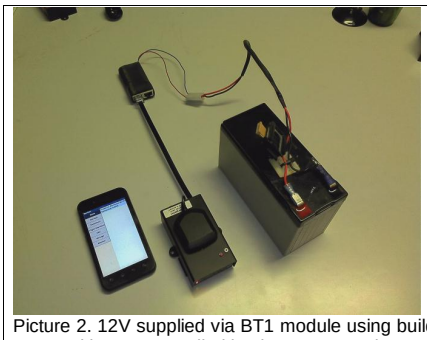
Troubleshooting

SoarTronic Bluetooth BT1 does not have any indication if it is working or not. This is because one LED lamp consumes about 8 mA of current, and *SoarTronic Bluetooth BT* shoud consume same or less that External Displlay unit. The FLARM units are build to supply 2 external displays, which consume together 90-100 mA. *SoarTronic Bluetooth BT* can be connected with FLARM unit in parallel with one (1) external unit only.

Each *SoarTronic Bluetooth BT1* module has been manually programmed for 19200 baud-rate and BT name & PIN code. That means that their operation has been tested, and if it does not show in your devices Bluetooth set-up menu, it is likely that the *SoarTronic Bluetooth BT1* does not get the 3.3V supply from the FLARM unit. Please double-check your wiring. Please refer to FLARM manual for IGC standard RJ45 and/or RJ12 pinout.

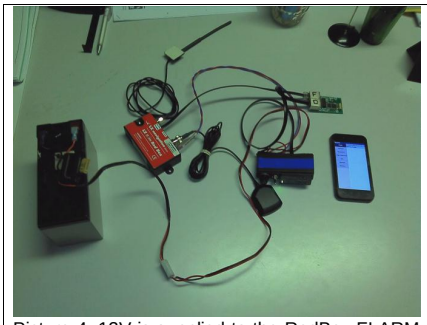
If *SoarTronic Bluetooth BT1* is visible in the Bluetooth device setup menu of your device's operating system, but your flight computer SW does not recognise it, or you are receiving odd characters (XCSoar Config / Gonfig / Config / Devices / monitor) instead or valid NMEA sentences, please make sure that your FLARM device is set-up to send data over 19200 baud-rate.

Trademarks:



Picture 2. 12V supplied via BT1 module using build-in 12V/GND connection points. BT1 module is powered by 3.3V supplied by the FLARM unit

Picture 3. 12V supplied via RJ45/RJ12 splitter build-in into the BT1 module. BT1 module is powered by 3.3V supplied by the FLARM unit



Picture 4. 12V is supplied to the RedBox FLARM. FLARM units supplies 3.3V to the BT1 unit and LX External Display. PT1 units is connected between the LX RedBox and the display unit. Apologies of the messy picture.

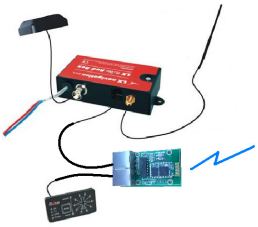
A.3. Soartronic Installation Examples

SoarTronic BT installation examples

RedBox FLARM with one ExternalDisplay

12 volts supply is provided to the RedBox using separate supply cables. External display is connected with IGC standard RJ12 cable.

(RedBox can also be supplied with 12V over the RJ connector, like MiniBox).

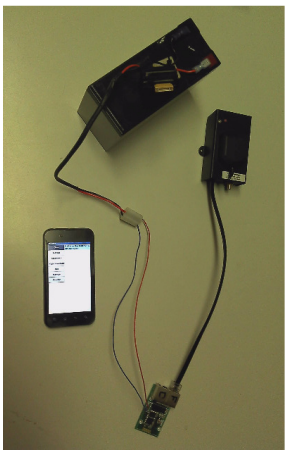


You can add the SoarTronic Bluetooth module between RedBox and the external display. You will need another RJ12 cable, that is identical with the cable originally between the RedBox and ExternalDisplay.

SoarTronic BT cocule connectors can be used with both RJ12 (6 ires) and RJ45 (8 wires) connectors.

PLEASE NOTE, that the RedBox unit can provide 100mA current for external displays and BT modules. One external display draws about 45 mA, and SoarTronic BT module about 40mA max.. Do not connect more that 2 devices like this to prevent overloading.

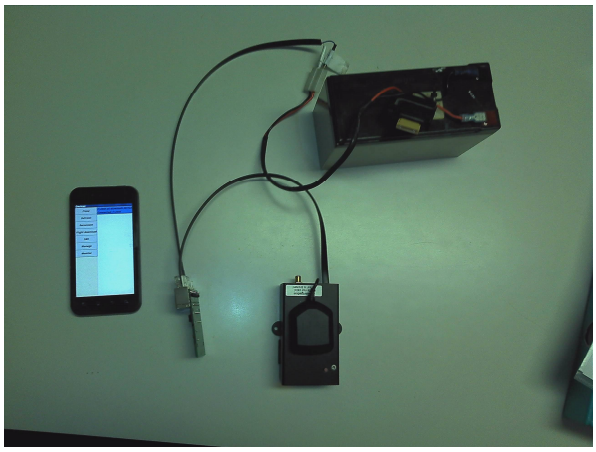
MiniBox FLARM with one ExternalDisplay
(Or original Swiss FLARM)



If you use MiniBox or original FLARM units, you have to feed operating power to your device using the same RJ connector as you use for data communication. To make installation easier, you can connect the 12V operating power to the SoarTronic Bt module. BT mnodule then connects the Vin and GND into IGC standard pins of the RJ connector. (this 12V is NOT used to power the BT module). Olease note, that the BT module does not have build in reverce current protection or fuse.

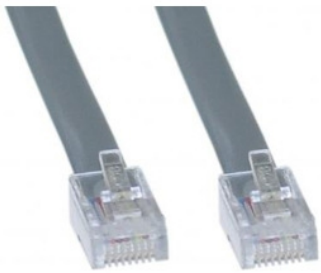
SoarTronic BT module is powered by the 3.3V provided by the MiniBod or original FLARM unit.

In this picture the second RJ connector, here marked with D (for Diplay) can be used to connect with an external display, for example. Please note, that SoarTronic BT module alone draws 40mA, and MiniBox can only provide about 100mA.



If your FLARM unit is already powered with a RJ cable, and you do not want to change the wiring, move the power cable from your FALRM unit to the Disp port of the SoarTronic BT1 module. Then add another IGC RJ cable to connect Flarm port of the SoarTronic BT module to the MiniBox or original FLARM

Please note, that if you have the original Swiss FLARM unit, only the wider, 8 wire RJ45 port transmits the FLARM trafic data on 19200 bauds communication speed.



SoarTronic BT1 module is build to operate with FALRM units, which are connected using IGC standard RJ12 or RJ45 connectors and standard external display cables. In this cable the connectors in both ends are 1:1 identical.

If you make such cable yourself using flat cable, in the streighened cable the connector clips point opposite directions.

SoarTronic BT module ahs two RJ45 connectors for 8 wire cables. However you can connect 6 wire RJ12 cables used with LX RedBox and MiniBox units.

If you are unsure, you can e-mail us (soartronic@gmail.com) and ask instructions.

We hope that SoarTronic BT module is useful for you!

Best regards,

SoarTronic team

A.4. Datasheet EGBT-046S

EGBT-045MS
EGBT-046S

Bluetooth Modules

Wireless UART Cable Replacement

Hardware Manual &
AT Commands Reference Manual Rev. 1r0

EGBT-045MS and EGBT-046S Bluetooth Module are low cost replacements of our now retired EGBC-04 Bluetooth Module. EGBC-04 is an excellent Bluetooth Module, it is fully certified to Bluetooth standards, and is loaded with programmable features users had come to love. There is just one thing that went against it- it is expensive.

It is easy to see why the EGBC-04 cost so much. Firstly, the manufacturer produced these specialty modules in relatively small volume; hence, there is no economy of the scale to speak of. Secondly, certification costs a lot of money; and this cost will have to be added on top of the manufacturing cost. Hence, EGBC-04 ended up costing about 10 times more expensive than its garden variety USB-type Bluetooth dongles cousins.

Fortunately, at least one volume manufacturer have came up with an idea of producing a generic Bluetooth module in large quantity, for sale and distribution to developers who now have to put only the firmware functionalities. This resulted in a huge drop in prices of these specialty Bluetooth modules, benefiting us experimenters and hobbyists.

EGBT-045MS and EGBT-046S are generic Bluetooth Modules loaded with SPP firmware for UART wireless cable replacement functions. The EGBT-045MS can be configured by the user to work either as a master or slave Bluetooth device using a set of AT commands.

EGBT-046S, on the other hand, is permanently programmed as Bluetooth slave device. EGBT-046S, because of its simpler function, is a lot easier to use, and of course, costs less than EGBT-045MS. You can use it straight out of the box as a UART wireless cable replacement, without any need to add set-up codes in your microcontroller application firmware.

The new EGBT-04 Bluetooth module comes in two flavors. The EGBT-046S is permanently configured as a slave device. EGBT-045MS, on the other hand, can be configured by the user to work as a master or slave Bluetooth device.

EGBT-04 modules can be soldered directly on a hi-rel type IC socket to make it easier to work with prototyping platforms, such as breadboards and perforated prototyping boards.

Use the cheaper EGBT-046S if your application will connect to a master Bluetooth device, such as PC or laptops. Use the EGBT-045MS if your application must connect to a slave Bluetooth device, such as with EGBT-046S. Note that EGBT-045MS will work as well as a slave Bluetooth device.

COMMON SPECIFICATIONS

Radio Chip:	CSR BC417
Memory:	External 8Mbit Flash
Output Power:	-4 to +6dbm Class 2
Sensitivity:	-80dbm Typical
Bit Rate:	EDR, up to 3Mbps
Interface:	UART
Antenna:	Built-in
Dimension:	27W x 13H mm
Voltage:	3.1 to 4.2VDC
Current:	40mA max

COMMON HARDWARE INTERFACING CONSIDERATIONS

The EGBT-04 module will work with supply voltage of 3.1VDC to 4.2VDC. When supplied with 3.3VDC, it will interface directly with the UART port of any microcontroller chip running at 3.3VDC.

When used with 5V microcontrollers, The TXD output logic swing of the EGBT-04 still falls within the valid 5V TTL range, hence, can be connected directly to the UART RXD of the 5V microcontroller host. EGBT RXD and inputs, however, are not 5V tolerant, and can be damaged by 5V level logic going in. Some level translation circuit must be added to protect the inputs.

A simple diode level translator circuit like the ones shown in Figure 3 and 7 will suffice in most applications. A better alternative is with the use of 5V input tolerant tiny logic chips such as 74LVC1G125 – a single buffer chip housed in smd sot23-5 package.

EGBT-046S PIN CONFIGURATION

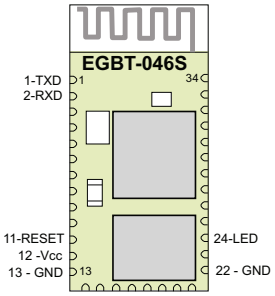


Figure 1. *EGBT-046S Pin Layout*

Table 1. EGBT-046S Pin Description

PIN	ID	DESCRIPTION
1	TXD	UART TXD Output
2	RXD	UART RXD Input
11	RESET	RESET Input
12	Vcc	+3.1 to 4.2VDC Power Input
13	GND	Common Ground
22	GND	Common Ground
24	LED	LED Status Indicator Flashing - Waiting to Connect/Pair Steady ON - Connected/Paired

Note:
All unassigned pins must be left unconnected.

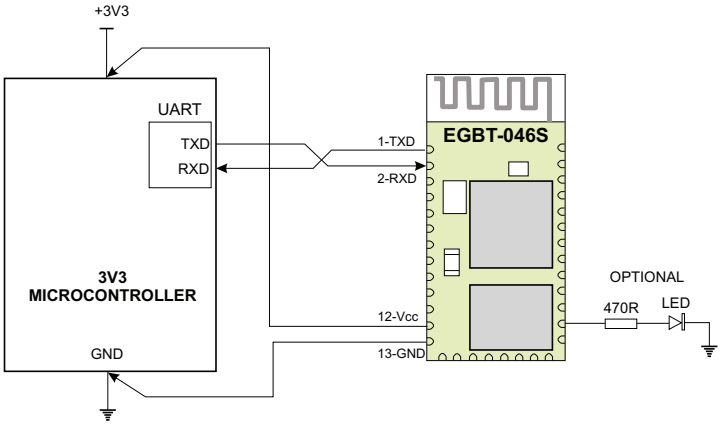


Figure 2. *EGBT-046S wiring example with a 3v3 host microcontroller. The 470R resistor and LED are for status indication, and may be omitted if not needed.*

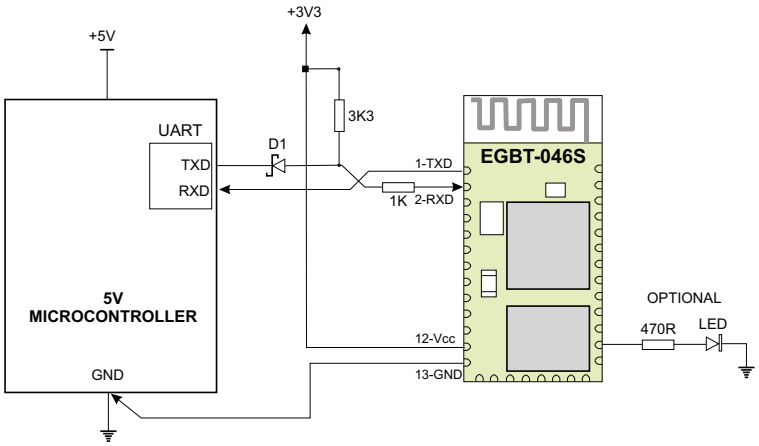


Figure 3. *EGBT-046S RX input is not 5V tolerant. A schottky diode connected as shown will keep 5V voltages out of the Bluetooth module when operated with a 5V host microcontroller.*

PREPARATION FOR USE

The EGBT-046S is permanently configured as a slave Bluetooth device. It works under the following default configuration:

Baud Rate: 9600 bps
Data : 8 bits
Stop Bits: 1 bit
Parity : None
Handshake: None

Passkey: 1234
Device Name: linvor

If the default configuration suits your application, then you can use EGBT-046S immediately. Once it is paired to a master Bluetooth device, its operation becomes transparent to the user. No user code specific to the Bluetooth module is needed at all in the user microcontroller program.

The EGBT-046S automatically sets itself up in Command Mode when it is not remotely connected (paired) to any other Bluetooth device. You can change the Passkey, Device Name, and Baud Rate while the EGBT-046S is in Command Mode by entering a small subset of AT style commands. Any changes made will be retained even after power is removed from the EGBT-046S, hence device configuration setup must not be repeated unless new changes need to be made.

You can do configuration setup using the host controller itself (the microcontroller in your own circuit), or a PC running a terminal software using a serial to TTL (or USB to Serial TTL) converter. See Figure 4 for connection details.

It is important to note that EGBT-046S does not wait for any termination character for each AT command entry. Instead, it acts to whatever character you entered after one second. Hence, if you are not able to complete a command entry within a second, it will be ignored. Because of this behavior, it may be extremely difficult to do manual entry configuration using Windows Hyperterminal software. Terminal software that allows batch sending of multiple characters must be used.

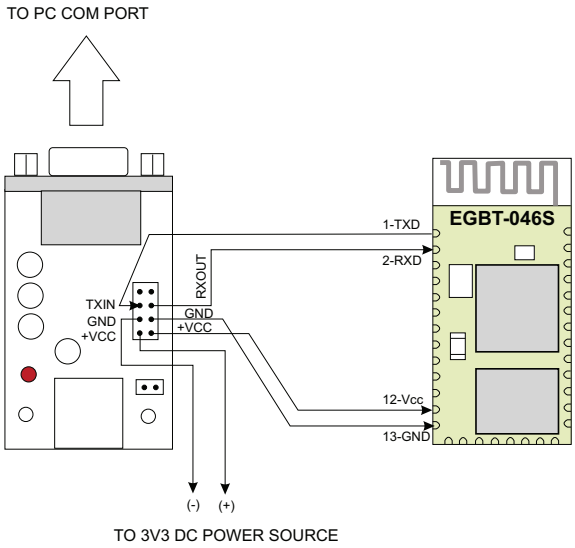


Figure 4. *A PC may be used to configure the EGBT-04. To connect to a PC COM port, a RS-232C to TTL converter is needed. This figure shows a wiring example using e-Gizmo RS-232 to TTL converter kit.*

EGBT-046S AT Command Set

1. TEST

Used to test the UART connection between the host controller and Bluetooth Module.

COMMAND	RESPONSE
AT	OK

2. Change Baud Rate

COMMAND	RESPONSE
AT+BAUD<p>	OK<r>

where:

<p> Paramater
<r> Response, set to nnnn bps

<p>	<r>	Remarks
1	1200	set to 1200bps
2	2400	set to 2400bps
3	4800	set to 4800bps
4	9600	set to 9600bps (Default)
5	19200	set to 19200bps
6	38400	set to 38400bps
7	57600	set to 57600bps
8	115200	set to 115200bps
9	230400	set to 230400bps
A	460800	set to 460800bps
B	921600	set to 921600bps
C	1382400	set to 1382400bps

Caution:
PC standard COM port hardware does not support baud rates in excess of 115200bps. If you are using a PC to configure EGBT-046S and accidentally set baud rate to these values, connection to a PC COM port will no longer be possible. Use of USB to Serial converter cable that can work at higher bauds may be necessary to re-establish a connection. Prolific PL-2303 based USB to Serial converter cables are known to work up to 921600bps.

Example1: Set baud rate to 57600bps

From Host controller:
AT+BAUD7
EGBT-046S Response
OK57600

Example2: Set baud rate to 4800bps

From Host controller:
AT+BAUD3
EGBT-046S Response
OK4800

3. Change Device Name

The EGBT-046S can be assigned a readable name of up to 20 characters in lenght.

COMMAND	RESPONSE
AT+NAME<name>	OK<name>

Example1: Set device name as EGBT-04

From Host controller:
AT+NAMEEGBT-04
EGBT-046S Response
OKEGBT-04

4. Change PASSKEY(PIN code)

Passkey (PIN Code) is a 4-digit code shared with a master Bluetooth Device (e.g. PC) to prevent unauthorized pairing.

COMMAND	RESPONSE
AT+PIN<nnnn>	OK<nnnn>

Where:

<nnnn> 4-digit passkey

Example1: Set PASSKEY to 5995

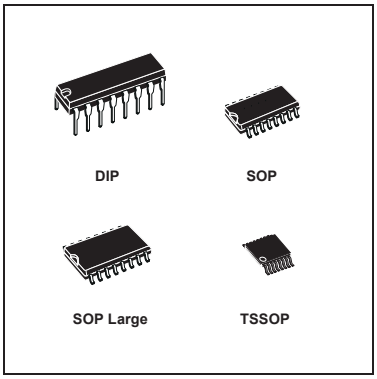
From Host controller:
AT+PIN5995
EGBT-046S Response
OK5995

A.5. Datasheet ST232

ST232

5V POWERED MULTI-CHANNEL RS-232 DRIVERS AND RECEIVERS

- SUPPLY VOLTAGE RANGE: 4.5 TO 5.5V
- SUPPLY CURRENT NO LOAD (TYP): 5mA
- TRANSMITTER OUTPUT VOLTAGE SWING (TYP): ±7.8V
- CONTROLLED OUTPUT SLEW RATE
- RECEIVER INPUT VOLTAGE RANGE: ±30V
- DATA RATE (TYP): 220Kbps
- OPERATING TEMPERATURE RANGE: -40 TO 85°C, 0 TO 70°C
- COMPATIBLE WITH MAX232 AND MAX202



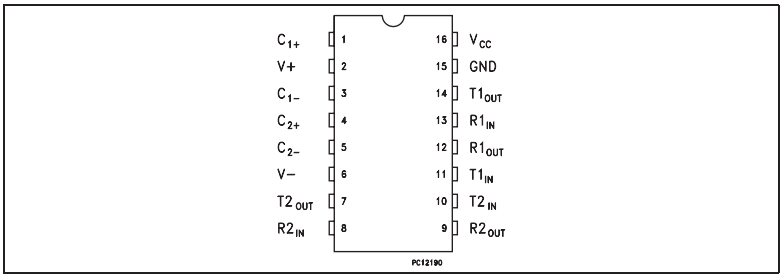
DESCRIPTION

The ST232 is a 2 driver, 2 receiver device following EIA/TIA-232 and V.28 communication standard. It is particularly suitable for applications where ±12V is not available. The ST232 uses a single 5V power supply and only four external capacitors (0.1µF). Typical applications are in: Portable Computers, Low Power Modems, Interfaces Translation, Battery Powered RS-232 System, Multi-Drop RS-232 Networks.

ORDERING CODES

Type	Temperature Range	Package	Comments
ST232CN	0 to 70 °C	DIP-16	25parts per tube / 40tube per box
ST232BN	-40 to 85 °C	DIP-16	25parts per tube / 40tube per box
ST232CD	0 to 70 °C	SO-16 (Tube)	50parts per tube / 20tube per box
ST232BD	-40 to 85 °C	SO-16 (Tube)	50parts per tube / 20tube per box
ST232CDR	0 to 70 °C	SO-16 (Tape & Reel)	2500 parts per reel
ST232BDR	-40 to 85 °C	SO-16 (Tape & Reel)	2500 parts per reel
ST232CW	0 to 70 °C	SO-16 Large (Tube)	49 parts per tube / 25 tube per box
ST232BW	-40 to 85 °C	SO-16 Large (Tube)	49 parts per tube / 25 tube per box
ST232CWR	0 to 70 °C	SO-16 Large (Tape & Reel)	1000 parts per reel
ST232BWR	-40 to 85 °C	SO-16 Large (Tape & Reel)	1000 parts per reel
ST232CT	0 to 70 °C	TSSOP16 (Tube)	only for samples
ST232BT	-40 to 85 °C	TSSOP16 (Tube)	only for samples
ST232CTR	0 to 70 °C	TSSOP16 (Tape & Reel)	2500 parts per reel
ST232BTR	-40 to 85 °C	TSSOP16 (Tape & Reel)	2500 parts per reel

PIN CONFIGURATION



PIN DESCRIPTION

PIN N°	SYMBOL	NAME AND FUNCTION
1	C_1+	Positive Terminal for the first Charge Pump Capacitor
2	V+	Doubled Voltage Terminal
3	C_1-	Negative Terminal for the first Charge Pump Capacitor
4	C_2+	Positive Terminal for the second Charge Pump Capacitor
5	C_2-	Negative Terminal for the second Charge Pump Capacitor
6	V-	Inverted Voltage Terminal
7	$T2_{OUT}$	Second Transmitter Output Voltage
8	$R2_{IN}$	Second Receiver Input Voltage
9	$R2_{OUT}$	Second Receiver Output Voltage
10	$T2_{IN}$	Second Transmitter Input Voltage
11	$T1_{IN}$	First Transmitter Input Voltage
12	$R1_{OUT}$	First Receiver Output Voltage
13	$R1_{IN}$	First Receiver Input Voltage
14	$T1_{OUT}$	First Transmitter Output Voltage
15	GND	Ground
16	V_{CC}	Supply Voltage

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	-0.3 to 6	V
T_{IN}	Transmitter Input Voltage Range	-0.3 to (V_{CC} + 0.3)	V
R_{IN}	Receiver Input Voltage Range	± 30	V
T_{OUT}	Transmitter Output Voltage Range	(V_+ + 0.3) to (V_- - 0.3)	V
R_{OUT}	Receiver Output Voltage Range	-0.3 to (V_{CC} + 0.3)	V
T_{SCTOUT}	Short Circuit Duration on T_{OUT}	infinite	
T_{stg}	Storage Temperature Range	-65 to + 150	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.
Note 1: No external supply can be applied to V+ terminal and V- terminal.

ELECTRICAL CHARACTERISTICS

(C_1 - C_4 = 0.1µF, V_{CC} = 5V ± 10%, T_A = -40 to 85°C, unless otherwise specified.
Typical values are referred to T_A = 25°C)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SUPPLY}	V_{CC} Power Supply Current	No Load, T_A = 25°C		5	10	mA

TRANSMITTER ELECTRICAL CHARACTERISTICS

(C_1 - C_4 = 0.1µF, V_{CC} = 5V ± 10%, T_A = -40 to 85°C, unless otherwise specified.
Typical values are referred to T_A = 25°C)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{TOUT}	Output Voltage Swing	All Transmitter outputs are loaded with 3KΩ to GND	± 5	± 7.8		V
I_{TIL}	Input Leakage Current				± 1	µA
V_{TIL}	Input Logic Threshold Low		0.8			V
V_{TIH}	Input Logic Threshold High				2	V
SR_T	Transition Slew Rate	T_A = 25°C, V_{CC} = 5V R_L = 3 to 7KΩ, C_L = 50 to 2500pF (Note1)		7	30	V/µs
D_R	Data Rate	(Note 2)	120	220		Kbits/s
R_{TOUT}	Transmitter Output Resistance	V_{CC} = V+ = V- = 0V V_{OUT} = ± 2V	300			Ω
I_{SC}	Transmitter Output Short Circuit Current	One T_{XOUT} to GND		±10	±60	mA

Note 1: Measured from 3V to -3V or from -3V to 3V.
Note2: One transmitter output is loaded with R_L = 3KΩ to 7KΩ, C_L = 50 to 1000pF

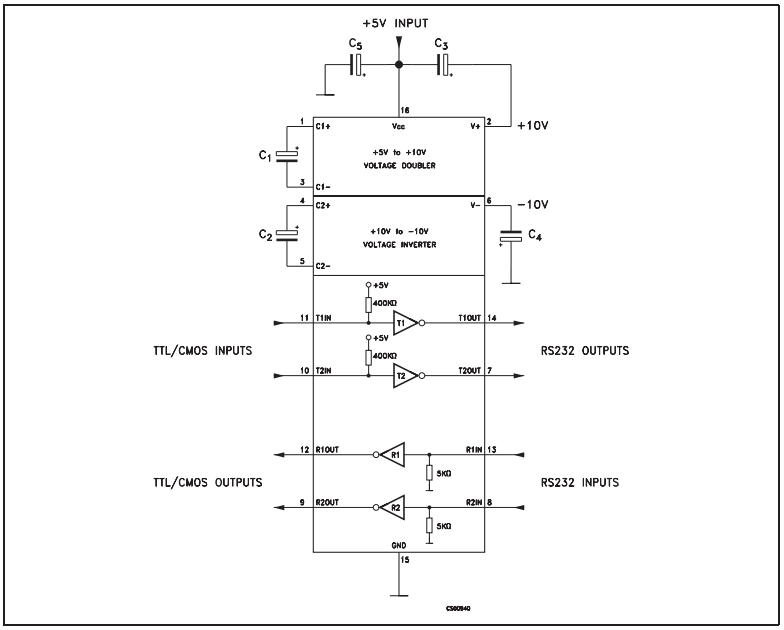
RECEIVER ELECTRICAL CHARACTERISTICS

(C_1 - C_4 = 0.1µF, V_{CC} = 5V ± 10%, T_A = -40 to 85°C, unless otherwise specified.
Typical values are referred to T_A = 25°C)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{RIN}	Receiver Input Voltage Operating Range		-30		30	V
R_{RIN}	RS-232 Input Resistance	T_A = 25°C, V_{CC} = 5 V, V_{RIN} = 5V	3	5	7	KΩ
V_{RIL}	RS-232 Input Logic Threshold Low	T_A = 25°C, V_{CC} = 5 V	0.8	1.2		V
V_{RIH}	RS-232 Input Logic Threshold High	T_A = 25°C, V_{CC} = 5 V		1.7	2.4	V
V_{RIHYS}	RS-232 Input Hysteresis	V_{CC} = 5V	0.2	0.5	1	V
V_{ROL}	TTL/CMOS Output Voltage Low	I_{OUT} = 3.2mA (to V_{CC})			0.4	V
V_{ROH}	TTL/CMOS Output Voltage High	I_{OUT} = -1mA (to GND)	3.5	V_{CC}-0.4		V
t_{DR}	Receiver Propagation Delay	C_L = 150pF (Note 1)		0.3	1	µs
I_{SCR}	Receiver Output Short Circuit Current			±10		mA

Note 1: RS-232 IN to TTL-CMOS OUT (from 50% to 50%)

APPLICATION CIRCUITS (note 1, note 2)



Note 1: C_{1-4} capacitors can even be 1µF ones.
Note 2: C_{1-4} can be common or biased capacitors.

CAPACITANCE VALUE (µF)

C1	C2.	C3	C4	C5
0.1	0.1	0.1	0.1	0.1

TYPICAL PERFORMANCE CHARACTERISTICS (unless otherwise specified T_j = 25°C)

Figure 1 : Supply Current vs Temperature

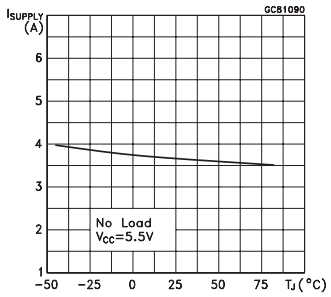


Figure 2 : Data Rate vs Temperature

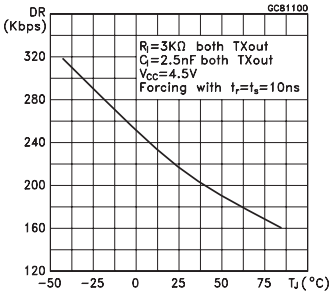


Figure 3 : Receiver Propagation Delay

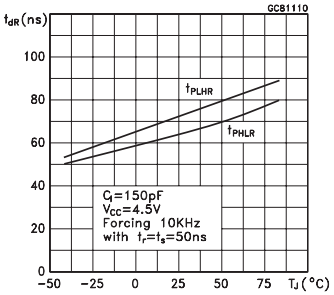


Figure 4 : Driver Propagation Delay

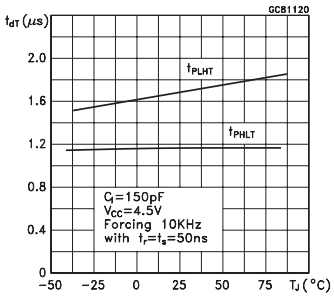


Figure 5 : High Level Output Voltage Swing vs Temperature

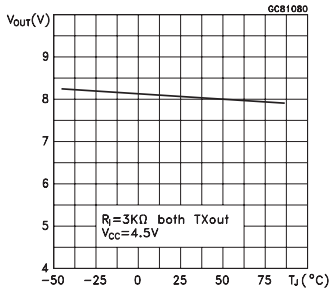


Figure 6 : Low Level Output Voltage Swing vs Temperature

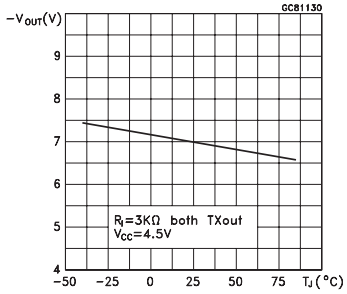


Figure 7 : High Level Transmitter Output Short Circuit Current vs Temperature

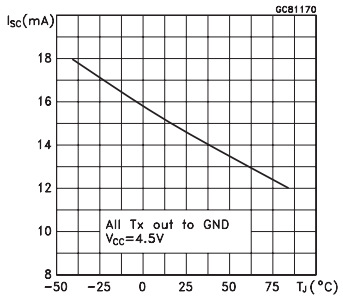


Figure 8 : Low Level Transmitter Output Short Circuit Current vs Temperature

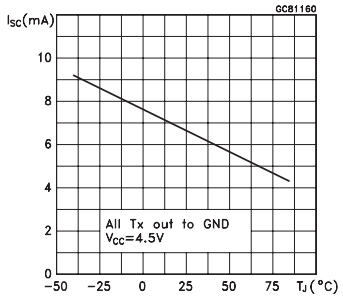


Figure 9 : High Level Receiver Output Short Circuit Current vs Temperature

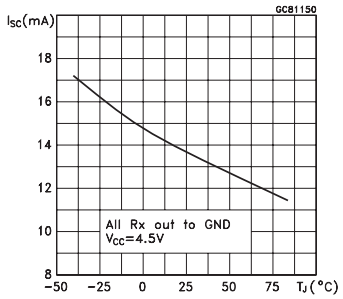
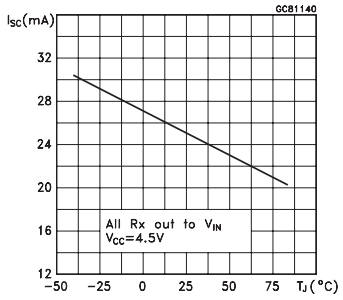
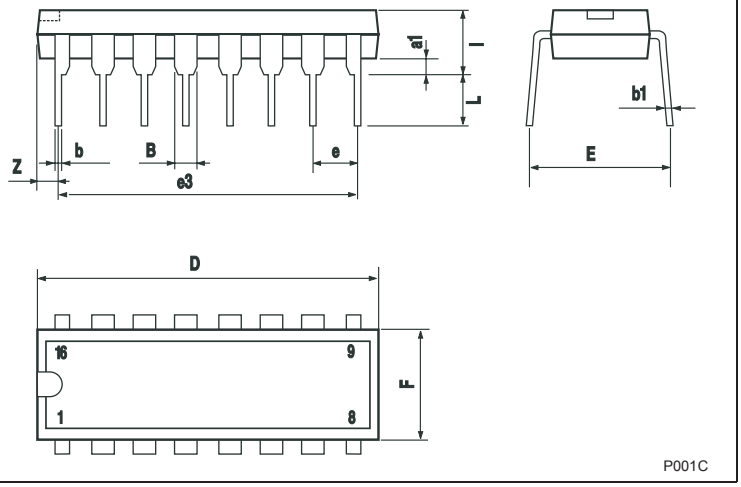


Figure 10 : Low Level Receiver Output Short Circuit Current vs Temperature



Plastic DIP-16 (0.25) MECHANICAL DATA

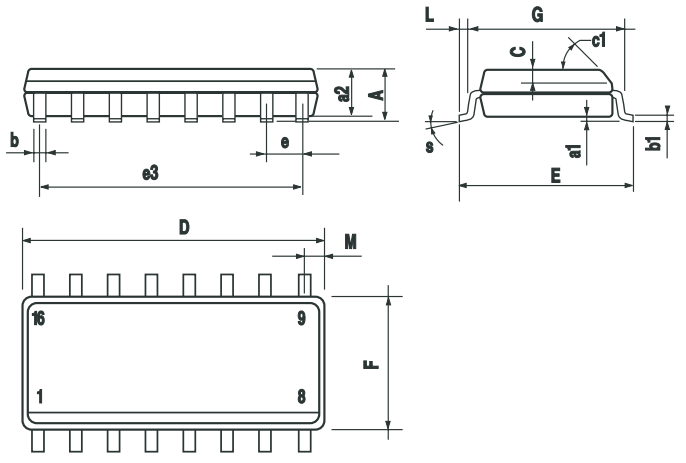
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



P001C

SO-16 MECHANICAL DATA

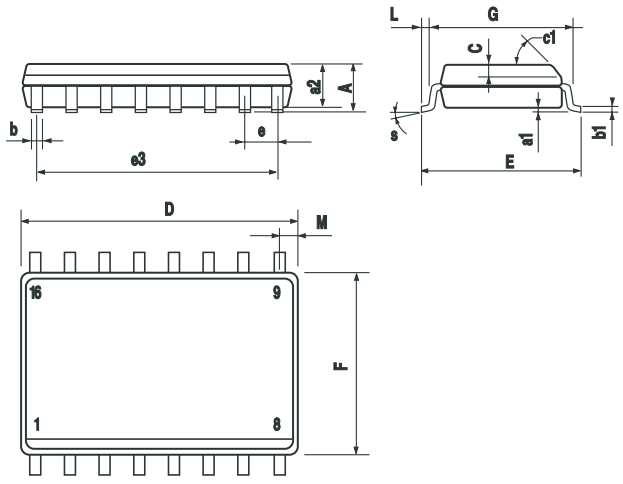
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.004		0.008
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8		° (max.)			



PO13H

SO-16L MECHANICAL DATA

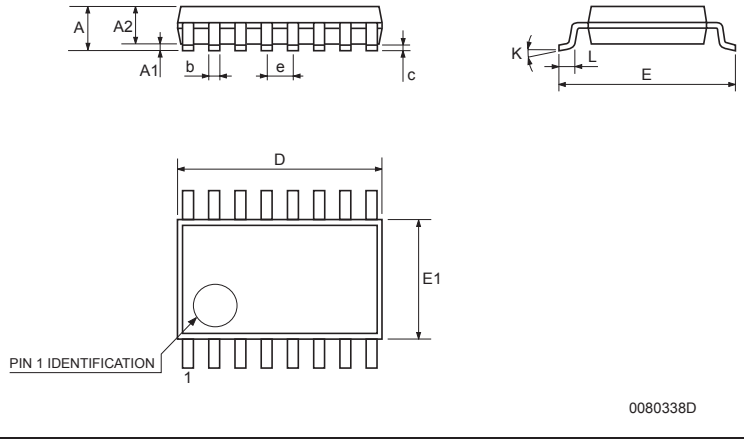
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			2.65			0.104
a1	0.1		0.2	0.004		0.008
a2			2.45			0.096
b	0.35		0.49	0.014		0.019
b1	0.23		0.32	0.009		0.012
C		0.5			0.020	
c1	45° (typ.)					
D	10.1		10.5	0.397		0.413
E	10.0		10.65	0.393		0.419
e		1.27			0.050	
e3		8.89			0.350	
F	7.4		7.6	0.291		0.300
G						
L	0.5		1.27	0.020		0.050
M			0.75			0.029
S	8° (max.)					



PO13I

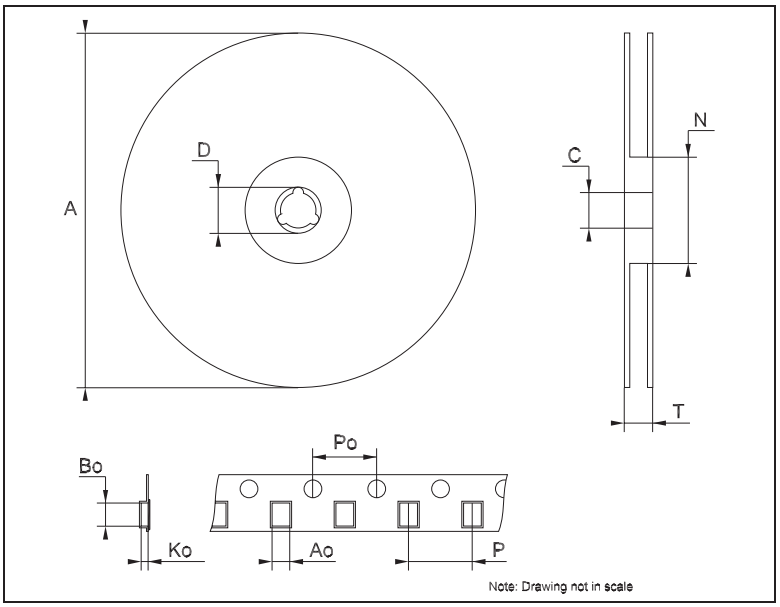
TSSOP16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0079
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



Tape & Reel SO-16 MECHANICAL DATA

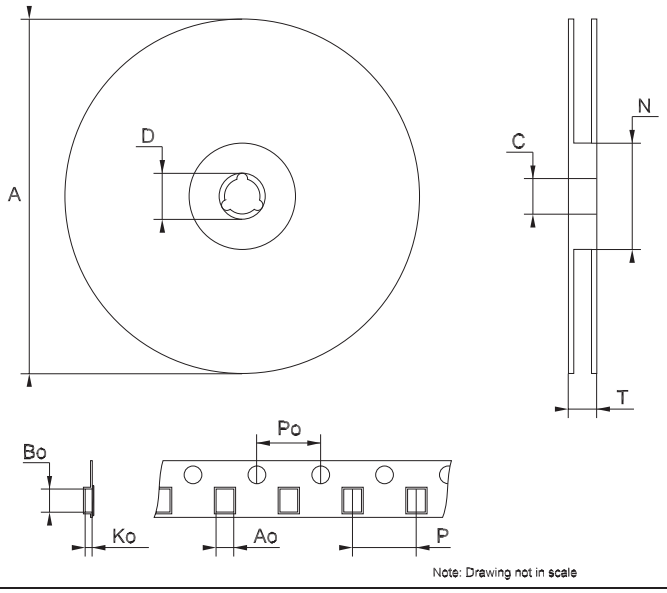
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.45		6.65	0.254		0.262
Bo	10.3		10.5	0.406		0.414
Ko	2.1		2.3	0.082		0.090
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319



Note: Drawing not in scale

Tape & Reel SO-16L MECHANICAL DATA

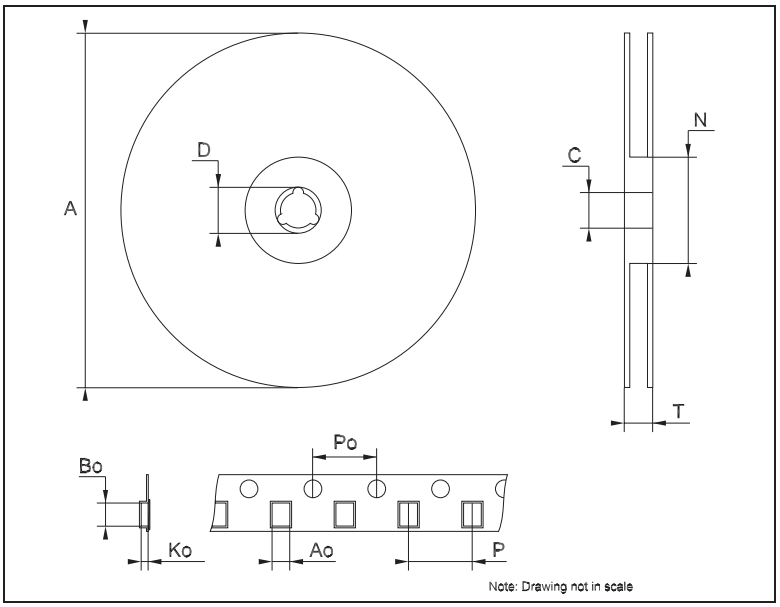
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	10.8		11.0	0.425		0.433
Bo	10.7		10.9	0.421		0.429
Ko	2.9		3.1	0.114		0.122
Po	3.9		4.1	0.153		0.161
P	11.9		12.1	0.468		0.476



Note: Drawing not in scale

Tape & Reel TSSOP16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.7		6.9	0.264		0.272
Bo	5.3		5.5	0.209		0.217
Ko	1.6		1.8	0.063		0.071
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319



Note: Drawing not in scale

B. Quellen

Soartronic:
http://www.soartronic.net/file.php?i=38&n=SoarTronic_Bluetooth_V.1_manual_version_001.pdf;
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http://www.soartronic.net/file.php?i=40&n=FLARM%20-%20BT%20connections%20explained.pdf;
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https://docs.google.com/file/d/0BxdLxDCD6HidSkRaRTVuNERrQjg/edit?pli=1; 04.04.2013

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http://www.datasheetcatalog.org/datasheet/stmicroelectronics/6420.pdf; 04.04.2013