Gemini Bluetooth instructions

Overview:
This is document details the development connection and use of cheap Bluetooth (BT) technology to control your Losmandy Gemini (1) mount via a computer thru the Gemini RS232 port.

BT devices have become cheaper and more readily available thru the internet and the aim of this project was to deliver cheap affordable BT telescope control.

Remember BT technology is not without inherent problems like: dropouts; limited range; limited data rates bandwidth; and interference, so how well it works can be dependent on you locality and radio noise environment, construction and devices used (aka transceiver). I can get 8~10m range indoors and around 20m outdoors.

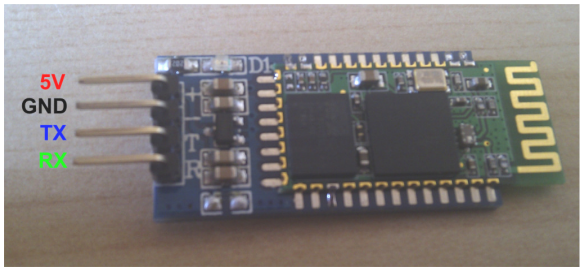
I naturally absolve myself of any damage that may result of construction and use of this device. That said it's not going to damage anything if my design is followed.

Parts required:
For this project I have a full parts list in excel format, see attachments. You can substitute on these as you hearts content but be aware your parts may not fit my PCB design nor work as specified. Parts like the RJ11 and +12V connector are readily available from electronics suppliers, but, I had to modify/design the RJ11 (using my PCB design software, see below) to suit my source of supply. I later purchased a different RJ11 and it would not fit (missed by .5mm on mounting lugs), so be mindful of the PCB parts library design I have used if you are substituting parts.

I have drawn up a PCB for this project using Eagle PCB freeware and have a full schematic and PCB drawing, so, you can make your own PCB or changes if you wish.

You do not need to use a dedicated PCB, you can fashion one from a vebro-board however be aware your BT transceiver module has an inbuilt antenna and keep shielding tracks and parts away from this area.

The BT transceiver module I used was a 5V TTL model: RF-BT0417CB which can be readily purchased from here (EBay store MDfly store or search the internet) for around $14 Aust ea (only 1 needed):
http://www.ebay.com.au/itm/Bluetooth-Wireless-TTL-Transceiver-Module-board-5V-232-/380342011945?pt=LH_DefaultDomain_0&hash=item588e268829

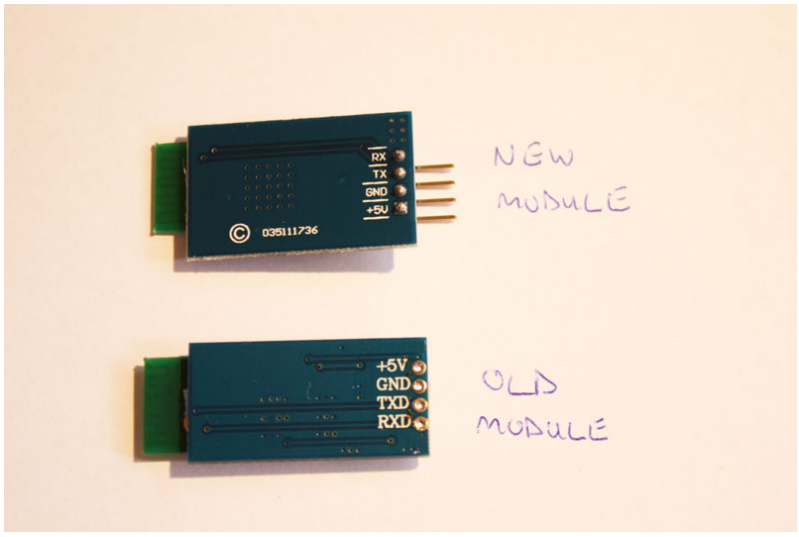


http://stores.ebay.com.au/MDflystore?_trksid=p4340.l2563

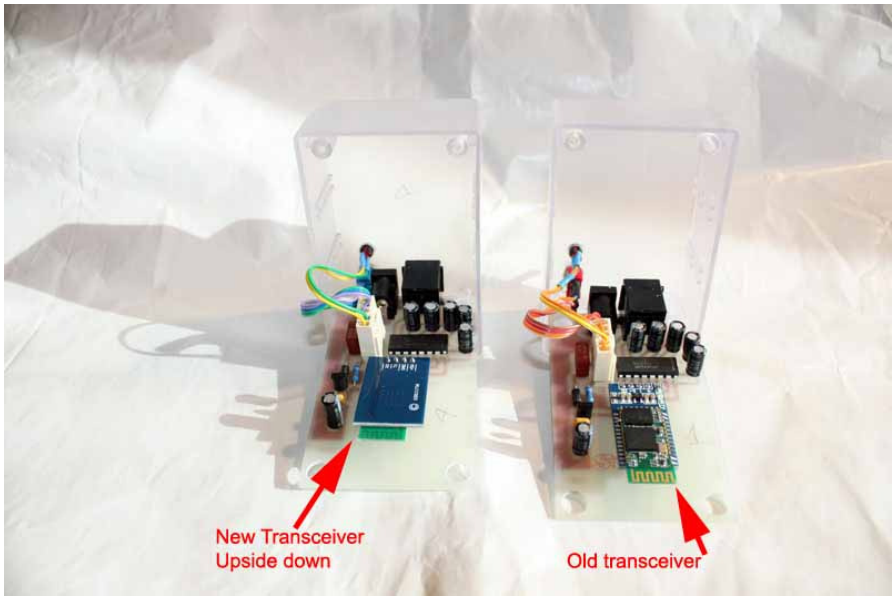
This transceiver is a 2.4Ghz BT module, +5V, Ver 2.0 + EDR registration (TTL out), Serial Port protocol (SPP) compatible up to 30ft (10m). Remember to buy the exact

model number as there are other versions (ie: 3.3V or without the backing PCB) with out the add ons you need for this project.

Important Change note*
The original BT modules I used (above) have been superseded however the new module is essentially the same as the old except the supplier has mirrored the pin configuration and changed the status LED from a red LED to a bright green LED. Thus the pin designations on the PCB will be incorrect to this PCB design….except! I found the easiest fix for this was to just invert the new module on my PCB (because the pins are mirrored it will fit straight in the correct designations. This does not interfere with the operation and this also attenuates the status LED brightness which is still clearly sill viewable thru the PCB & case. That said I have also provided an alternate PCB design if you want to build the BT with the status LED upright.



New and old transceivers, note pin configuration



New and old transceiver mounted on PCB.

If you need a BT dongle (aka your laptop does not have inbuilt BT) then they can be readily purchased from eBay and such like: eBay store (TOMTOP) for $1 Aust ea (only 1 needed):
http://cgi.ebay.com.au/ws/eBayISAPI.dll?ViewItem&item=200468996304&ssPageName=STRK:MEWNX:IT

http://stores.ebay.com.au/tomtop-home?_trksid=p4340.l2563

If your computer (Laptop) already has an inbuilt BT dongle then you do not need this above dongle.

I made the PCB to fit a small transparent plastic case so I could see the status LED thru the case. Some black plastic cases may contain carbon which may interfere with the transceiver so be aware of this. The other parts are readily available however be aware prices may vary and Parts like the RJ11 may vary in design and not fit. Please check your RJ11 against my drawing specification listed below.

OS & Software:
The transceiver/BT dongle need no drivers except inbuilt MS software, XP/Vista/Win7 or any OS that has inbuilt BT control. You can read more details about the transceiver from the MDfly electronics store here.

I did originally have some issues with my Laptop BT MS software (see below).There are a number of ways to overcome this however the easiest for me was to downloaded and use Toshiba BT stack software, which cured all issues, read on for more on this.

BT Stack ports:
Bluetooth control software uses virtual ports stacks created by MS Bluetooth virtual stack (or a 3rd party vendor such as Toshiba BT stack or Bluesoleil). I found the MS software (in my case, Win XP pro, 32bit) can have an issue in correctly writing the COM port values and sometimes you get funny port numbers like "COMo9" or "COM9c" or such like. I found this happened to me on a WinXP and also on a different Win7 machine. Some other users have reported this issue but most users will never see this. Another WinXP home netbook I use for astro work did not have this issue. I just mention this as I faced this hair pulling exercise.

This COMM port value problem is the stack software not writing the nul value for the port number correctly. If you have this issue then find the COM ports you are using for outgoing and incoming by opening the device manager and finding the respective ports. You can also easily find these ports by right clicking on the BT radio icon. The fix is enter "regedit" (this may only work till next re-boot):

HKEY_Local_Machine/Hardware/Devicemap/SERIALCOMM

Now edit the value for the port by deleting the COM port value for your outgoing port, mine was "COM9", then re-entering "COM9" (without quotes) (or what ever the BT COM ports are). Do the same for COM10 port (or what ever the BT COM ports are).

\Device\Bthmodem0 REG_SZ COM9….edit this COM9 and re-enter COM9.
\Device\Bthmodem1 REG_SZ COM10…edit this COM10 and re-enter COM10.

Ok you may now point out that your are just entering the same data that is already there, but this is only partly correct. The MS stack assignment has written values you cannot see unless you look at the binary data values in reg-edit. If you have "funny" COM port numbers then there are "hidden null" values there you cannot see. Deleting this COM port data and re-entering them re-writes the values.

As mentioned an easier fix for all this is to use a 3rd party BT software, see above.

Transceiver:

The transceiver module, BT0417CB, is a 4 pin module with built in aerial with TTL output levels (see above **note** on the Alternate BT module design) and can operate as a Serial Port Profile (SPP) output. This allows us to use this module to communicate to the Gemini RS232 via a MAX232 for RS232 level transition.

Be careful handling the transceiver (or any electronic part) as is can be damaged by Electro Static Discharge (ESD).

The Transceiver has a passkey of: 1234. You will be prompted for this when setting up the connection. The Transceiver usually sets itself as COM9 (out). Be sure you have it powered when setting up the BT system on your computer. You can manually assign COM ports for this device in XP device manager.

You can change this passkey with a simple windows HyperTerminal connection but I couldn't be bothered, see the OEM transceiver notes on this.

BT Dongle:
Basically I purchased a cheap dongle that just plugs into a spare USB port! This device will usually set itself as COM10 (in). Ensure it is assigned in COM port as above.

Ensure the transceiver is powered on when setting up the BT system to pair the Transceiver with the dongle.

If you have inbuilt BT then you do not need a dongle!

Gemini RS232 and PCB circuit design:
I have drawn up a circuit schematic and single sided PCB using Eagle PCB Freeware. Eagle PCB freeware is an easy to use fully functional PCB design suite and the freeware allows for PCBs up to 100mm x 80mm. This design fits well within the freeware specification limits so users can modify this circuit and PCB as they desire. This circuit was designed for minimum cost (around $40 ~$50 per module) and ease of manufacture by almost anyone.

I reduced the +12V to +5VCDC (for the transceiver & Max232) using a small 78L05, +5V, 100mA regulator. D1 is just a simple schottky protection diode.

This circuit can be powered from any DC source between +8V to +18V (and more), such as from the spare Gemini DC power jack. I did this as +12V is usually readily available. The power jack is centre pin positive. The circuit is protected by a 125mA TE5 fuse. I used these TE5 fuses as they have a small footprint and are cheap. Obviously if this fuse blows, then you have a problem and this should be rectified before replacing the fuse and powering on.

I measured the BT transceiver and it draws around 45mA in stdby and 30mA (@+5V) connected.

I interfaced the BT transceiver to the Gemini RS232 using a Max232 IC. I won't go into the design philosophy suffice to say this is a very basic design. The Max232 output (RS232) is routed out the RJ11 which is connected to the Gemini.

Notice how I orientated the RJ11 pins wrt to the Gemini and how I orientated the connectors on the RJ11 cable. It is important to get the orientation of this connector jacks correct. If you do not, it won't do any damage to the Gemini but it won't work.

The +12V PCB connector jack has “mill layer” in its pad design, so, if you are going to have this PCB made, ensure the supplier can accommodate a milling layer as some cannot do this. Alternately you can oversize the pads of the device and bore with a larger drill or file slots. I made quite a few PCB in design phase using the Laser Toner method however these had varying results and I had the final PCB made by a PCB supplier for me.

Parts like the RJ11 and +12V connector are readily available from electronics suppliers, but, as I said, I had to modify the RJ11 to in my design to suit my source of supply. I purchased a different RJ11 and it would not fit, so be mindful of the parts library design I have used if you are substituting parts and check that your parts (like the RJ11) fit my dimensions!

note
Notice how I have drawn the RJ11 jack dimension, as viewed from the top thru to its pins. This is how you view the PCB layout, in Eagle PCB, thus I have drawn the Jack and pin dimensions with this in mind. See attached image for my RJ11.

Also note that on the original model transceiver I removed the 4 pin right angle SIL connector (the connector that was fitted from the supplier) and soldered in my own 4 pin straight SIL from the rear direction (see PCB and images). I did this as I wanted orientation of the transceiver a different way and the transceiver has a LED on it that I wanted to be able to see. If you use the newer alternate transceiver, inverted, then you do not need to do this.

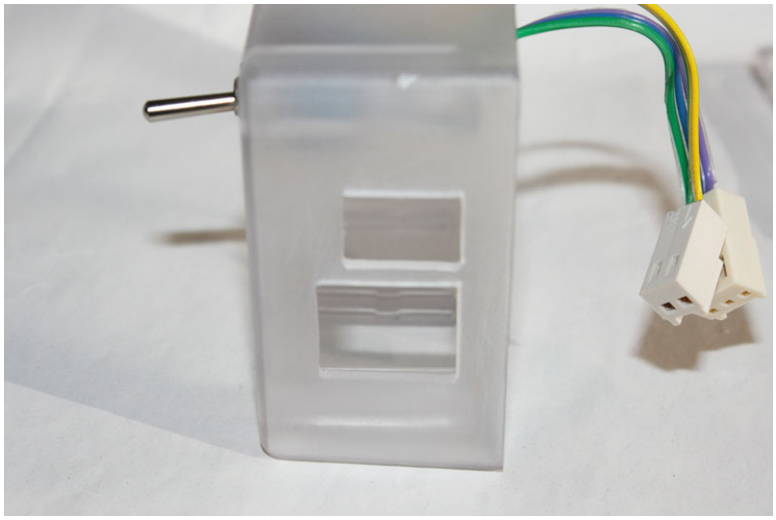
This also allowed me to sit the transceiver proud of the PCB so as help reduce interference. It’s a bit of a bugger of a job to do all this and an easier way is to just bend the SIL connector legs around so they can fit the PCB holes however this looks “ugly”.

If you remove the SIL connector ensure you orientate the transceiver onto the PCB correctly wrt its pins. If you use the new transceiver ensure you orientate it upside down onto the PCB or use the Alternate PCB design.

Construction:
I won’t go much into the PCB construction, suffice to say ensure your components are polarity orientated correctly. Ensure you orientate the polarity sensitive parts correctly, see the schematic for this.

I designed the case in such a manner that it hangs by a small lanyard from the G11 Gemini mount handles with the power and RJ11 jacks downwards so any dew moisture will not flow into these. Operation of the device should keep dew off the PCB etc but I did coat my PCB with a conformal spray coating. Don’t get this in the jacks!

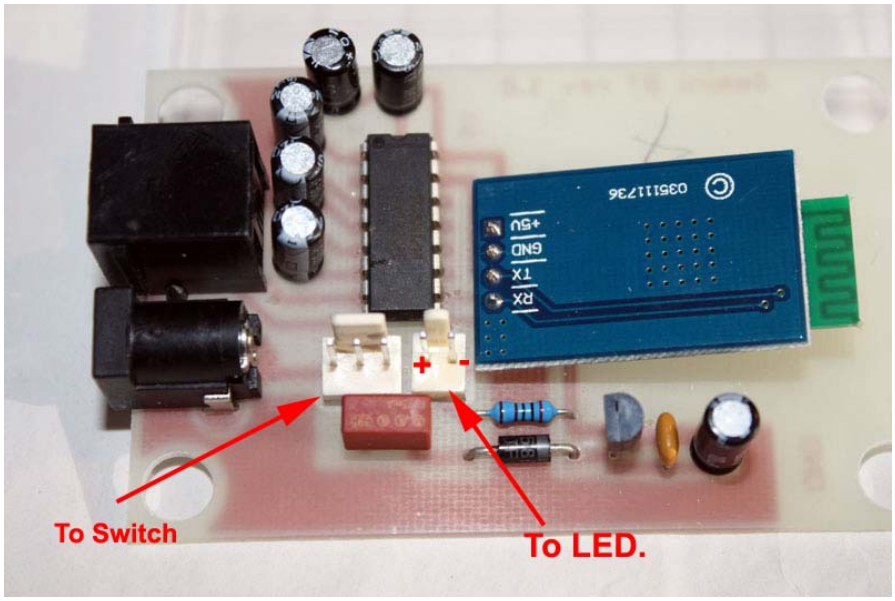
Don’t make the case power and RJ11 jack cut-out holes too large, I found I could oversize drill the PCB mount holes by around 1mm which allowed me to mount the PCB at an angle over the mount posts (near the jack holes) then lowering it so it fits into the jack holes neatly. Thus you do not need to oversize the jack holes to allow the PCB to fit. See attached pictures.



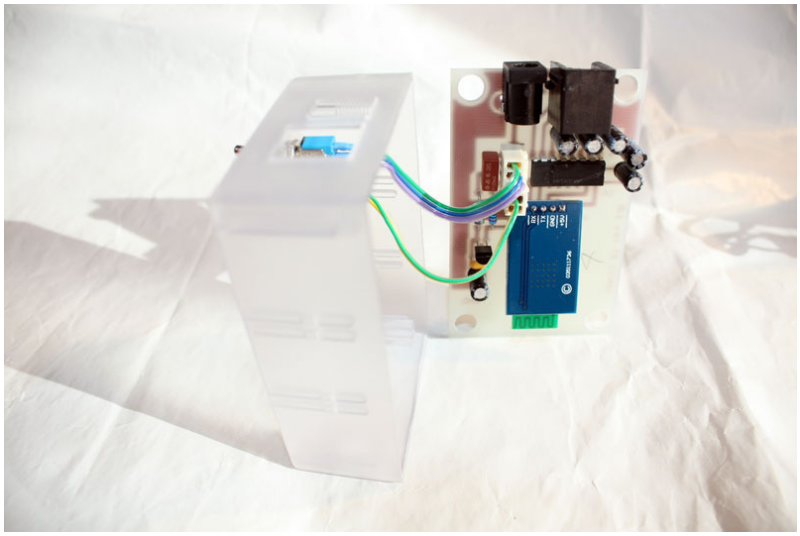
Case jack cut-outs and switch/LED lanyards.

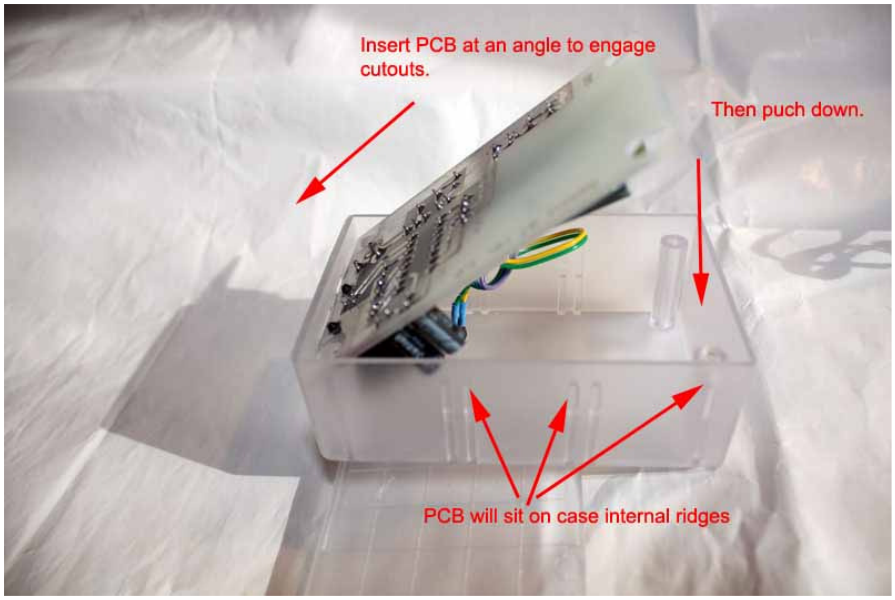
The switch and power LED needs to mounted as well. I used small cable lanyards and Molex SIL connectors for this instead of direct PCB mounting. It's just the way I do things. Place the switch and LED near the jacks so they will not interfere with the transceiver antenna, see pictures.

You also need to make a 4 pin RJ11 cable (desired length is to your liking however I made this around 400mm long) with a 4 pin connector on each end, one end to the transceiver module the other plugs into the Gemini RS232. Ensure you get the orientation of these wires/pins correct; see attached schematic interconnection on this. I used old flat telephone cable for this. Of course you need a RJ crimper to do this; they are quite cheap, $10 or so.



PCB close up with new transceiver. You cannot wire the switch lanyard incorrectly if you use an "on/on" switch. The LED is easy to orientate correctly (LED + is marked on image) as the PCB has Ground marked as "GND".





Fitting PCB into case.

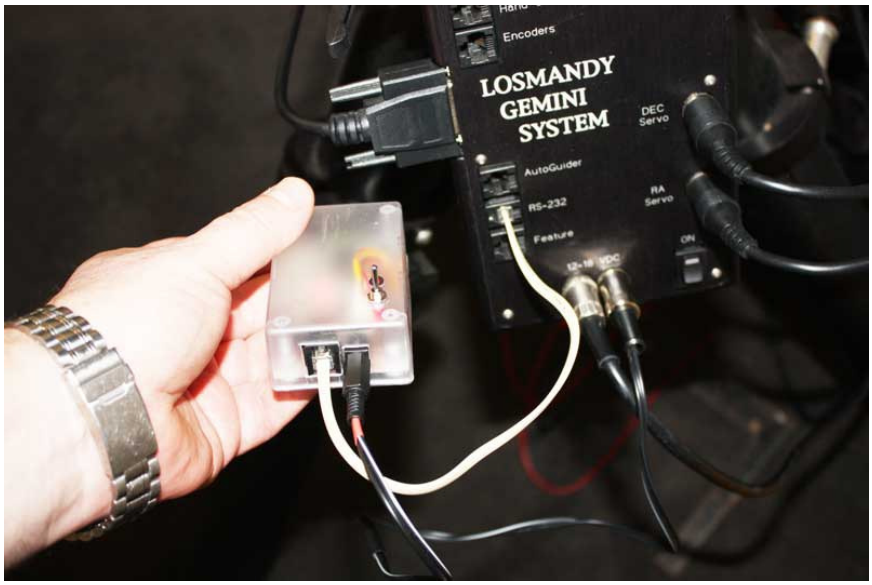

Assembled Module. Note where I placed the switch and power LED, away from transceiver.

Powering on:

Once all made, plug the device into a +12V DC source. Switch on the device and the power led will illuminate and the transceiver status LED will start flashing.

If it passes this it is ready to use.

Connection and Operation:
Power off the device and connect the BT RJ11 to the Gemini RS232 RJ11 using the 4 pin RJ11 cable. Connect power to the BT module then switch it on. The LEDs will illuminate as stated above.

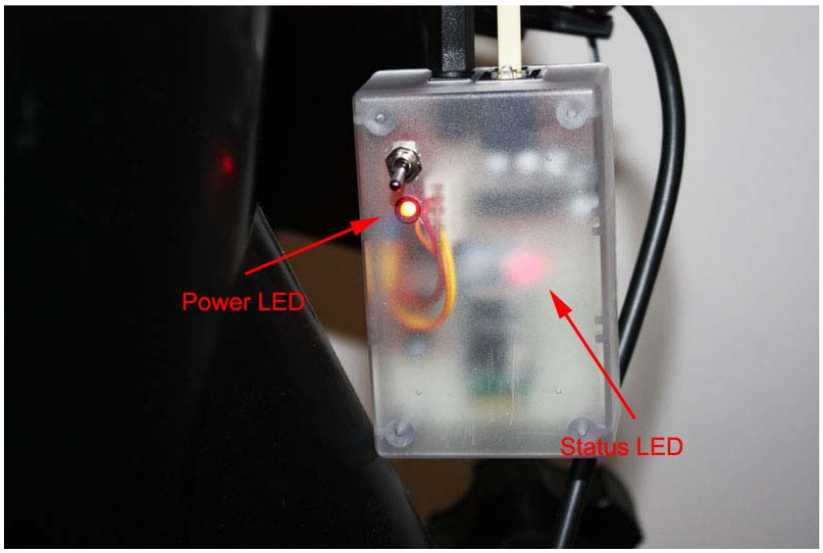


Shows power and RJ11 connections between components.

Now pair the device with your laptop BT. This is easily done as you can prompt your BT software to search for devices in range. It will/should discover the Gemini BT device and assign a COM port to it and ask for a passkey. If you use a BT dongle it will also assign a COM port for it as the incoming port and the transceiver COM port as the outgoing device.

Once paired you are ready to connect to the Gemini ASCOM driver. Just start Gemini ASCOM and enter the "Configure Telescope setup" menu. In this, enter your Transceiver COM port number (found using you computer BT software or device manager) and set you Baud rate for lest say 9600bps. I have tested connection speeds up to 115200bps but I only see small improvement using such a higher baud rate (like a little more responsive to key strokes). That's said, higher baud rates are more prone to dropouts.

Anyway, once entered, go back to the Gemini ASCOM "virtual hand-paddle" screen and select "connect". The system will connect to the transceiver, the virtual-hand paddle will display the Gemini data (after a slight delay) and the transceiver status LED will stop flashing and be fully lit.



You can see the Status LED is easily seen thru the case. The New transceiver LED is green and quite bright so I suggest you mount this new transceiver (if you have that module) transceiver upside down like I did.

Oh I forgot, un-tick the search for COM ports ……

You can now control all Gemini ASCOM functions thru the connection just like an RS232 but without the wires.

One last thing! I noticed if I travel out of range (with my laptop) then re-enter range the BT device disconnects then re-connects automatically. If you pressed key-strokes on the virtual hand set when outside range, once you re-enter the key strokes will be performed once re-connected. The BT transceiver has a buffer?

Just be aware of this.

Enjoy!

Brendan

Attachments:
Attached are resources you may need to construct this project.

MDFLY store:
RF-BT0417CB transceiver
http://www.mdfly.com/index.php?main_page=product_info&cPath=8&products_id=769

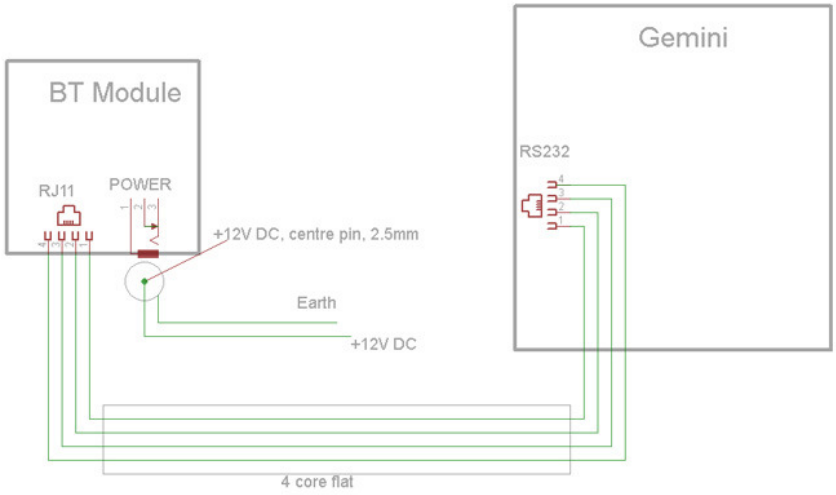
EBay Tom Top Dongles:
http://stores.ebay.com.au/tomtop-home?_trksid=p4340.l2563

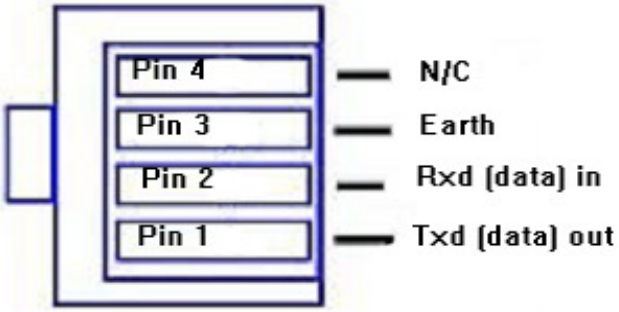
Eagle PCB free:
http://www.cadsoftusa.com/freeware.htm

Parts List:

Qty req'd per module complete	CCT designation	Item	Notes
1	Case	Case for PCB, UB5 clear (83 x 54 x 31)	Case, clear plastic designated "UB5", 83mm x 54mm x 31mm outside dimensions.
1	PCB	PCB as per eagle PCB design, 50mm x 79mm single sided.	PCB per design.
1	R1	2K ohm 1/4W 1% Metal Film Resistor	
4	C1, C4, C5, C6, C7	1µf electrolytic Capacitor, 50V	5mm pitch spacing
2	C3	10µf electrolytic Capacitor, 50V	5mm pitch spacing
1	C2	.33µf monolithic Capacitor, 50V	5mm pitch spacing
1	D2	1N5819, Diode Schottky	
1	F1	Fuse 125mA or 160mA miniature, TE5 sub-miniature.	
1	RJ11	PCB Connector Socket 4/4 modular RJ11	Ensure the one you purchase fits the PCB design
2	J2	Connector plug 4/4 modular, RJ11 for flat cable	Qty 2 req'd. One for the RJ11 the other for to connect to the Gemini.
1	IC1	MAX 232 logic level shifter for RS232	
1	LED1	Led, red, 3mm, low I draw	Power LED
1	LED clip	LED case clip, 3mm	Just a little 3mm plastic clip to hold the power LED
1	IC1	78L05, 5V regulator 100mA	
1	BT 4 pin	Bluetooth transceiver, eBay, BT0417C, +5V, inbuilt aerial Buy 5	Check which module you have, the new or the old.
1	Dongle	BT dongle	If required.
1	SW1	Input power Switch, sub miniature	Sub-miniature “on/on” type
1	Sw plug	Male polarized 3 header pin, .1"	
1	Sw conn	Female polarized 3 ping connector, .1"	
1	LED plug	Male polarized 2 header pin, .1"	
1	LED conn	Female polarized 2 ping connector, .1"	
5	Pins conn	Polarised pins 5 per board	For above .1" connectors.
1	Solder	As required	
1	Wire	5 core multi strand ribbon per metre (~150mm per module)	To make the LED and switch lanyards.
1	Wire	4 core telephone cable flat (~400mm per module)	
1	Plug	Power plug, male 2.5mm centre, 5.5mm outer, 9.5mm shaft length	Module Power plug, 2.5mm centre.
1	Jack	Power jack PCB, 2.5mm centre	PCB jack, 2.5mm centre.
1	Wire	Power jack cable (length as req'd)	Cable for the power plug.
1	DIN	4 Pin Din plug	If required, if powering module from Gemini spare 4 pin DIN connector.
1	Heat shrink	Heat shrink, 1.5mm black (As req'd PCB)	Cover switch and LED lanyard solder joints.
1	Ancillaries	PCB conformal spray lacquer	Spray the PCB to stop corrosion.

Module Schematic Interconnection:



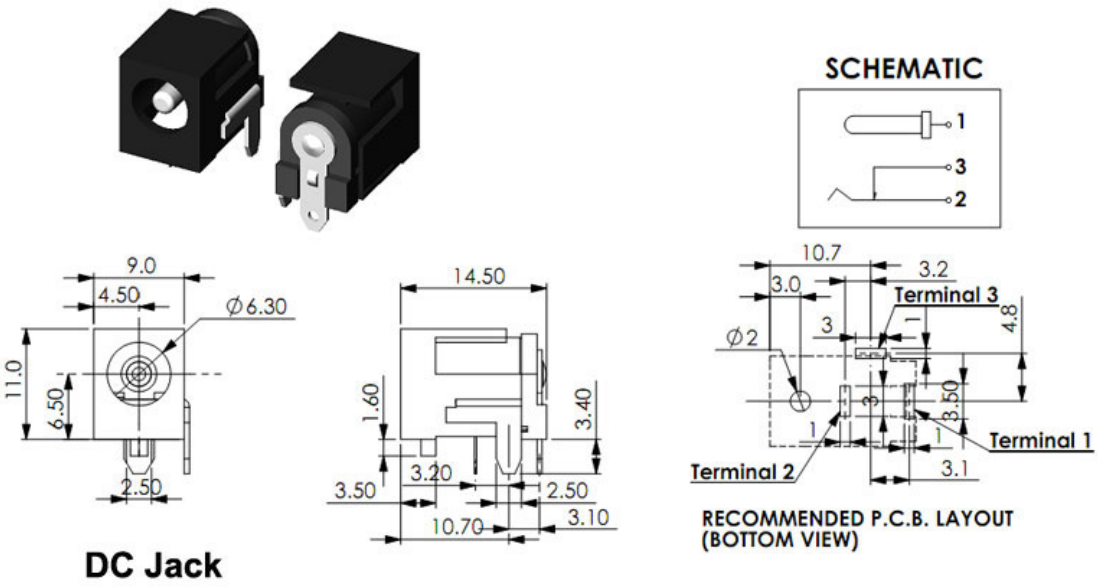


Gemini Serial Port Pin assignments

Pin 1 to Pin3 (RS232, 9 Pin plug)
Pin 2 to Pin 2 (RS232, 9 Pin plug)
Pin 3 to Pin 5 (TS232, 9 Pin plug)

This Gemini connector is called a RJ11 in Australia, RJ22 in USA, RJ10 in Europe?

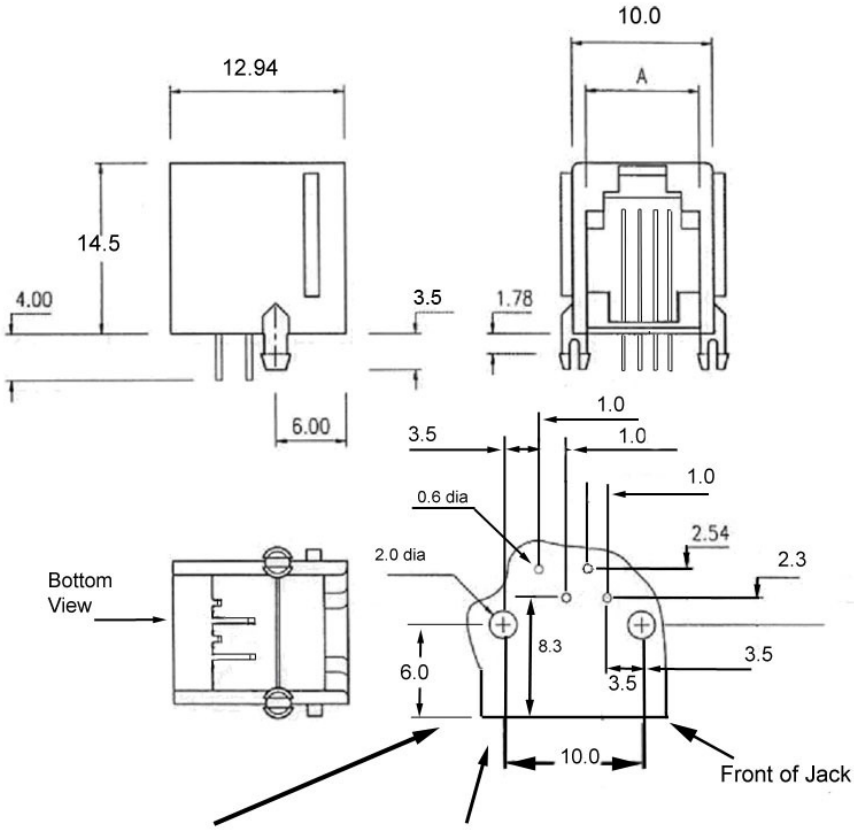
Connectors:
Power Jack:



DC Jack

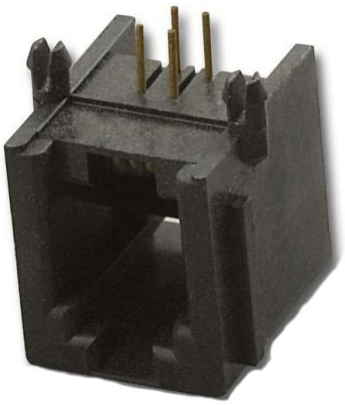
RJ11.

You can use a different RJ11 (to that above) as long as it fits the mount hole and drill dimensions/positions. If it does not then you need to either source an RJ11 that fits or re-design the part in Eagle PCB.

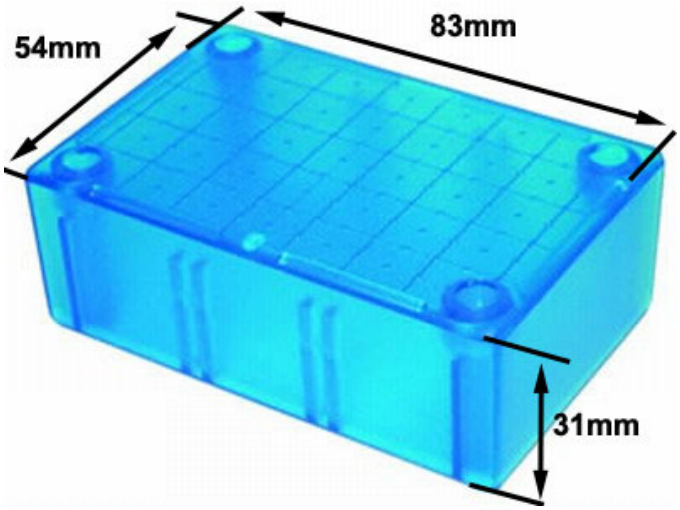


Part #	A	B
RJ11		

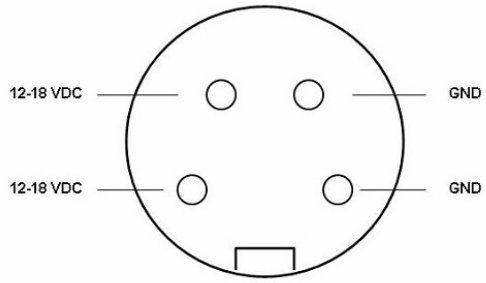
My RJ11 Dimensions



CASE:



8.10 Power Connector Pinout



Power Connector

Gemini Power Connector

Acknowledgements:
I'd like to thank a few gents in helping me and showing me the light….. and indeed the inspiration to undertake this BT design and inception:

Hiker Bob, from the IceInSpace (IIS) Australian Astronomy forum (for the inspiration);

paulkccd, from Gemini ASCOM and other internet forum fame (for guidance and sage words).

Mark Crossley, from Gemini ASCOM and other internet forum fame (for guidance and sage words); and

Tom Hilton, from Gemini ASCOM fame and other internet forum fame (for guidance and sage words).

Thanks Gents for the support and help that is rarely acknowledged but gratefully received!

This project is fully freeware for all to enjoy. Please don't build them and try to make a handsome profit…an octal hex on you if you do.

If you are not electronically inclined and would like one of these then maybe we can talk about building one for you. The cost would be parts and postage. No labour, however, that said I cannot make dozens of these without passing all cost such as consumables, PCB manufacture etc, so this has yet to be decided. Maybe there is someone nearby who can make this for you?