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Bluetooth Digital Setting Circles

This variation on my Digital Setting Circles project was created by Craig Combes. He provided the following content so others could recreate his version. Thanks, Craig!

Many people use Dave's serial DSC board with a serial to Bluetooth adapter and that can get quite pricey, large and power hungry. So I adapted Dave's design to skip the RS232 circuit and go straight to Bluetooth. In the process, I decided to change the PIC to a less expensive, and more recent chip: the 16F628A, which Dave had code for already. I made some minor tweaks to the code to eliminate some pull up resistors.

The new design uses a 5 volt regulator (to make sure the encoders are happy) and a 3.3 volt regulator to supply everything else (the Bluetooth module needs 3.3v). I used a MOSFET for polarity protection to reduce the input voltage requirement. I also replaced the oscillator module with a crystal to reduce cost and power consumption. The Bluetooth module is a surface mount device and the boards I created have 11 pads to solder for this device. Most of the other components (not the PIC) are surface mount also, but there aren't many of them and their are only a few pins maximum per component to solder, so it's not difficult.

The Bluetooth module is the RN-42 from Roving Networks, which only uses 30ma when transmitting, 3ma when "sniffing" and 26ua when sleeping. I have it configured to communicate at 9600 baud. For more info on the RN-42, you can go here:

http://www.rovingnetworks.com/rn-42.php (http://www.rovingnetworks.com/rn-42.php)

D1 is the power on indicator LED. SW1 is the reset button for the RN-42 and the PIC. D2 is the status indicator light for the RN-42. D2 blinks until connected, then it stays on.

I do have boards made for this circuit and I will eventually make them available through FAR Circuits, like Dave's original board. I am open to suggestions for improving the design/board. Just send me a note here (mailto:combes57@yahoo.com?subject=Comment from Bluetooth DSC Page).

Here is the schematic diagram (click to enlarge):
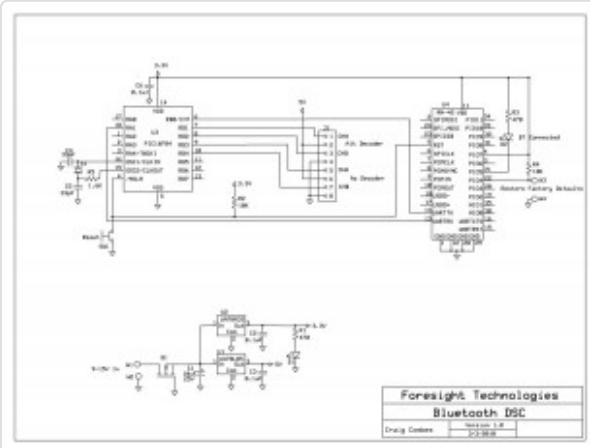
(http://eksfiles.net/wp-
content/uploads/2010/05/bluetooth_dsc.jpg)

Bluetooth DSC Schematic

The parts list:

Part	Description	Mouser Part No.	Price
R1 & R3	470 ohm resistor		
R2 & R4	10k ohm resistor		
R5	1.6k ohm resistor		
C1	10uF 15V aluminum electrolytic capacitor		
C2, C3, C6	0.1uF 10V (or greater) capacitor		
C4, C5	33pF 10V (or greater) capacitor		
D1, D2	LED		
Q1	P-Channel MOSFET	863-NTR1P02T1G	$0.36
U1	UA78L05 5v Voltage Regulator	595-UA78L05ACPK	$0.48
U2	UA78M33 3.3v Voltage Regulator	595-UA78M33CDCYR	$0.60
U3	Microchip PIC16F628A Microcontroller	579-PIC16F628A-I/P	$2.07
U4	Roving Networks RN-42 Bluetooth Module	765-RN-42	$19.95
SW1	Normally Open Pushbutton switch		
J1	Dual RJ-11 jack		
X1	Crystal ±20ppm 4MHZ Fundamental	815-ABL-4-B2	$0.39

Right-click here to download the .hex file for the PIC (http://www.eksfiles.net/wp-
content/uploads/2010/05/bluetooth_dsc.hex).

Here's a picture of the completed board (click to enlarge):
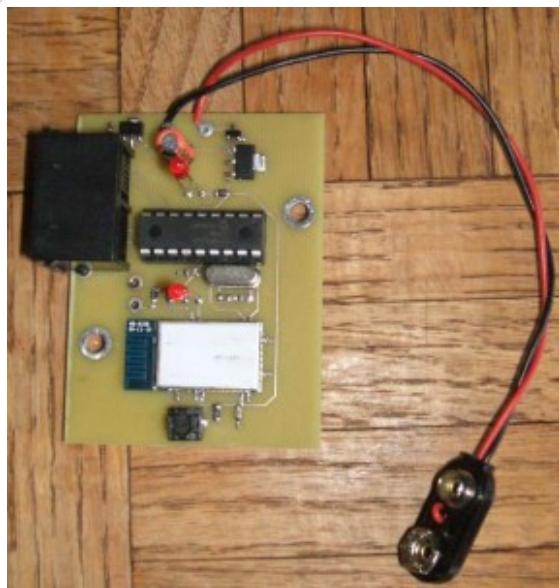
(http://eksfiles.net/wp-
content/uploads/2010/05/bluetooth_dsc_boa
rd.jpg)

Completed Bluetooth DSC board

29 thoughts on "Bluetooth Digital Setting Circles"

Harshad (http://twitter.com/h__r__j) said on October 20, 2010 at 12:56 pm (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-569):

Can I use this with a high resolution encoder 48K CPR?

Will the hardware be able to handle that frequency of clicks. For a push-to telescope, I guess the max rate will be 1/4 revolutions per second = 16K per second. Considering two encoders, that would be net 32K per second.

Not only frequency, would the protocol support that man bits for reporting the current click-count?

For the client software I don't worry much, because I will be writing my own software. Just as long as the protocol allows it.

Thanks,
Harshad

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=569#respond)

Harshad (http://twitter.com/h__r__j) said on October 20, 2010 at 1:17 pm (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-570):

Heh! I screwed up my math. The max rate would be 1/4 rps = 12K per second. For two encoders that would be 24K per second.

Would the PIC be able to handle that rate?

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=570#respond)

Dave (http://Website) said on October 21, 2010 at 8:13 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-572):

Harshad, the max my circuit can handle 64K quadrature tics per revolution. If the gear ratio between the telescope axis and the encoder is 1:1, then that means that your encoder must not be more than 16K CPR (because 1 CPR = 4 quadrature tics). If the gear ratio is different than 1:1, adjust accordingly. The limit is due to the fact that the decoder box uses only 16 bits to store the current encoder position.

That being said, there is little to be gained by exceeding 10-20K encoder tics per revolution. I usually recommend getting 1000 or 1024 CPR encoders (again, assuming 1:1 gear ratio). That gives you a resolution of about 0.1 degrees. Any additional encoder precision is wasted on mount errors, alignment errors, slippage, etc.

I've never been able to make my decoder box miss counts when using ~ 4000 tics/rev (1000 CPR). I'm not sure what the upper limit is for not missing counts–you might be able to do as high as 10,000 counts/sec, but that's probably stretching it.

Dave

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=572#respond)

Harshad (http://twitter.com/h__r__j) said on October 21, 2010 at 8:30 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-573):

Thanks Dave!

Craig seems to have changed the PIC. Will that or any other change affect the max rate it can support?

I would like to go for a low frequency encoder too, but I found a good deal on eBay, which tempted me: http://bit.ly/bYEoGB (http://bit.ly/bYEoGB)

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=573#respond)

Dave (http://Website) said on October 21, 2010 at 8:39 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-574):

Craig replaced the 16F84 with the 16F628, but he's still clocking it at the same rate because the PIC code depends on a 4-MHz clock rate (for timing of the serial communications at 9600 baud). So, the max rate will be the same as before.

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=574#respond)

KITTU (http://Website) said on December 16, 2010 at 4:04 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-601):

HI..

CAN YOU SEND THE SOURCE CODE REFERENCE
I AM WORKING WITH SAME MODULE BUT MY CONTROLLER IS DIFFERENT

THANK YOU

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=601#respond)

Joel said on November 2, 2011 at 8:37 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-1503):

Hello Dave,

i have a question about the use of the pic16f628:
on the schematic adapted for the bluetooth communication it appears that you still connect rs232 (TX/RX)
communication line to pins RA1 and RB0. But the pic16f628 have dedicated USART pins (RB1 and RB2). Is the
schematic wrong or is it by purpose? Are
the hex file (the bluetooth one and the normal one) compatible with the two microcontrollers?
Thank you!

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=1503#respond)

Dave (http://Website) said on November 2, 2011 at 9:03 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-1505):

Joel, the schematic is correct. I did port the code over from the 16F84 to the F628, but didn't change it to use the 628's
onboard UART. The only reason I ported it was because the 628 is cheaper than the 84. When Craig did the BT
version, his code changes were done simply to eliminate some pullup resistors. I don't think his hex code is compatible
with the 84.

Dave

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=1505#respond)

Bradley Roseberry said on November 27, 2011 at 8:01 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-2098):

Dave,

Is this BT board and PIC available at Far Circuits?
If not then would it require a PIC programmer since I do not see a ISP port on the board?

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=2098#respond)

Dave (http://eksfiles.net/) said on November 27, 2011 at 8:51 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-2099):

Bradley, you might email Craig Combes directly (he's the one who came up with this design) to see if he has any more
boards/chips for this project. There's a link above to his email address.

Dave

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=2099#respond)

joel said on May 26, 2012 at 3:55 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-5380):

Hi Dave, all

I have finally finished my DSC based on this circuit but with a wifi-rs232 module (roving network RN-XV or RN-171 or
equivalent) instead of the bluetooth.
The "road" was a little bit tricky, but now it works. So i can connect to my dsc with an iphone/ipod touch and skysafari
for example!!!
Somethink to know, is that by default these wifi modules send to the local uart (wired) some messages which are
creating troubles and prevent the good function!These messages are HELLO at the connection, and OPEN and CLOS
each opening/closing of the ports (which is done by the iphone/ipod software,each query…)). So before doing anything
it is mandatory to setup the module with null messages for that (quite simple: in command mode, send "set com close
0" then "set com open 0", then "set remote 0" then save to the module!! it is well documented in their datasheet)

Thank you for this nice circuit!!
Joël

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=5380#respond)

Joël said on May 27, 2012 at 3:07 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-5402):

Dave,

by the way, with skysafari, it doesn't look to be possible to program the resolution in the encoder (skysafari do not send resolution setting queries). So i have to write it in "hard" so to speak in the encoder code. Can you tell me where they are located in the hex file, so that i can modify it easily with my own values?
REgards
Joël

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=5402#respond)

Dave (http://eksfiles.net/) said on May 27, 2012 at 9:17 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-5409):

Joel, the easiest way to get the encoder resolutions into the box would be to use my testing program (EkBoxTester.exe (http://eksfiles.net/wp-content/uploads/2009/07/EkBoxTester.exe)). The resolutions are stored in EEPROM, so once they've been sent to the box once, they'll remain in the box even when powered off (or until different resolutions are sent).

Hope this helps –

Dave

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=5409#respond)

Dina said on November 4, 2012 at 10:13 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-7450):

hi
I was wondering what about the CTS & RTS on the rn-42
do they need to be connected to something in order to transmit and receive data by Bluetooth
and please I want to ask does it matte if am using a different PIC micro controller
in my project am using PIC16f877A and I want to interface it to the rn-42 HID module does it have the same interface ?

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=7450#respond)

Dave (http://eksfiles.net/) said on November 4, 2012 at 10:21 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-7451):

No, the CTS and RTS aren't used.

The PIC chip used in my interface doesn't know about the RN-42 module at all. It's simply transmitting serial data at TTL voltage levels (the same data/voltages that go into the MAX232 chip to be converted to RS-232 levels in the serial version of my board). The only thing that should be necessary is to make sure the RN-42 baud rate is set to the correct rate coming from the PIC (in the case of my circuit, 9600 baud).

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=7451#respond)

Joe said on March 4, 2013 at 8:27 pm (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-9354):

Can anyone supply schematic to use the RN-171 with the DSC so i can connect to my iStuff?

I bought a completed bluetooth dsc from Craig and it works great with my windows laptop, but won't pair with my iPhone or iPad.. actually they don;t even see it.. anyways, i'd like to build one using the wifi module and need help.

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=9354#respond)

Dave (http://eksfiles.net/) said on March 5, 2013 at 10:56 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-9360):

Unfortunately, Apple has locked down bluetooth in the iPhone and iPad, at least according to the Sky Safari FAQ (http://www.southernstars.com/support/faq/skysafari.html) (see questions 18 and 19). Only Apple-approved accessories will work.

Regarding a wifi version, I'm not able to help you there–I have no experience with a wifi version or trying to construct one. Perhaps there is a serial-to-wifi converter of some sort you could employ.

Dave

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=9360#respond)

Joel said on April 13, 2013 at 3:05 pm (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-9961):

Joe,

there is a small module by roving network (RN-XV) which is doing a serial to wifi convertion. (see my message of 26 may 2012 above. It is working almost ok with a board close the one of craig (replace the bluetooth by the RNXV, not pin to pin compatible, but wiring should do the job).
Joël

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=9961#respond)

Rob O'Toole said on May 4, 2013 at 8:19 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-10628):

Question … I would like to add encoders to an altaz mount (DM-4) and interface this to my Nexus-7 tablet which I just got. It has Bluetooth support. I installed Sky Safari Plus which I like.
Can I just add this board and that's it? Do I need anything else (besides the encoders)?

This looks like a clean solution.

Regards,
Rob

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=10628#respond)

Dave (http://eksfiles.net) said on May 4, 2013 at 2:42 pm (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-10634):

If Craig still has any of these boards, then that's it–all you need is encoders. An alternative is to build my serial board and use a serial to bluetooth converter, as described here. (http://eksfiles.net/2011/06/bluetooth-adapters-for-my-digital-setting-circles/)

Dave

jeff (http://none) said on September 30, 2013 at 10:45 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-14093):

can this device be connected to an interface

Mourad said on November 29, 2014 at 9:12 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-23458):

Hi Dave
I succesfully made your USB DSC board. I thank you so much for making this avilable. It's working great.
Now I want to go bluetooth. Just wondered wether I can use another cheap bluetooth module from China here is the link
http://www.aliexpress.com/item/Bluetooth-Serial-Transceiver-Module-Base-Board-For-HC-06-HC-07-HC-05-or-for-Arduino/1950687056.html (http://www.aliexpress.com/item/Bluetooth-Serial-Transceiver-Module-Base-Board-For-HC-06-HC-07-HC-05-or-for-Arduino/1950687056.html)
Will it still run fine with the board ?
As it's requiring 3 to 6 V power source, would it be ok if I can squip the voltage regulator and power it directly ?
A final question too : Can I just use the hex file for the usb version of your DSC. Would it still work for bluetooth ?

Thanks.

Mourad said on November 29, 2014 at 9:40 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-23459):

Sorry, here is the link to the module
http://www.aliexpress.com/item/HC-06-Bluetooth-serial-pass-through-module-wireless-serial-communication-from-machine-Wireless-HC06-for-arduino/630840325.html (http://www.aliexpress.com/item/HC-06-Bluetooth-serial-pass-through-module-wireless-serial-communication-from-machine-Wireless-HC06-for-arduino/630840325.html)

Dave (http://eksfiles.net/) said on November 29, 2014 at 10:31 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-23460):

You should be able to use that module for BT, but I don't know if you can modify the USB board for that. It works better to build the serial version of the board and then adapt that to BT. If you want to use the USB board, you'll have to unplug the USB cable and then add a voltage regulator to the circuit.

An example of adapting serial to BT using that module can be found in one of my other projects, the BT adapter for my KX3 ham radio (http://eksfiles.net/a-build-it-yourself-bluetooth-serial-interface/).

Dave

Markus said on February 24, 2015 at 4:55 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-23576):

hello

I built the BDSC and it works so far also quite good, but unfortunately I have a few problems at a higher resolution.
I use the following encoders
http://www.digikey.com/product-detail/en/AMT102-V/102-1307-ND/827015 (http://www.digikey.com/product-detail/en/AMT102-V/102-1307-ND/827015)
These have a maximum resolution of 2048 PPV ie 8192 tics
But if I set about 512PPV it starts to jump,
Mounted these are direct to the axes of my Dobson
About the technology

I use a 7 "Tablet with Skysafari and HC-05 Bluetooth module

Sorry for my bad english

Yours sincerely

Markus

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=23576#respond)

Dave (http://eksfiles.net/) said on February 24, 2015 at 8:47 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-23577):

Markus,

What do you mean when you say "it starts to jump"? Are you talking about the cursor on the screen on SkySafari that is supposed to show you where you telescope is pointed? If it's moving erratically, then the problem may be between your BT module and the tablet. I haven't used that particular module so I don't know what might cause that, but if communications between the two aren't smooth, you might see that as a result. The first thing I'd do is check all soldering and connectors to make sure you don't have any poor electrical connections. After that, make sure you've interface the HC-05 correctly and that its internal settings (baud rate, stop bits, parity, etc) are correct.

I've used SkySafari in the past with the serial version of my DSC board and a commercial serial-to-BT adapter, and it's worked fine. So I think SkySafari is up to the task.

Other thoughts: the DSC board checks the encoders at a high enough rate that it should not be missing any encoder tics due to rapid revolution of the encoders. I'm more suspicious of either the encoders themselves (I've never seen a type like this before so I don't know how reliable they are), or it's possible that your connections between the board and the encoders are not good (maybe a poor solder joint or connector).

Hope this helps –

Dave

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=23577#respond)

GigiG (https://sites.google.com/site/gigimysite/astro) said on September 1, 2015 at 2:59 pm (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-23633):

Hi Dave. Is it possible to use this type of Magnetic Encoders?
http://ams.com/eng/Products/Position-Sensors/Magnetic-Rotary-Position-Sensors/AS5040
(http://ams.com/eng/Products/Position-Sensors/Magnetic-Rotary-Position-Sensors/AS5040)
Thanks

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=23633#respond)

Dave (http://eksfiles.net/) said on September 1, 2015 at 3:11 pm (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-23634):

I think you'd have to add some additional circuitry, or do some extra work of some sort, to program this encoder prior to using it in the circuit. It's not a drop-in replacement for the US Digital optical encoders that I recommend.

Dave

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=23634#respond)

Bill Thomas (http://yubagold.com) said on August 12, 2016 at 6:16 am (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/#comment-24299):

Can't replace a standard DSC e.g., Argo Navis DSC with this Bluetooth Bbox, without rewiring the RJ45 connector (the "J1" circuit encoder inputs), being the encoders are swapped, and the Channel A and Channel B are also swapped.

Reply ↓ (http://eksfiles.net/digital-setting-circles/bluetooth-digital-setting-circles/?replytocom=24299#respond)

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