Square dance recording with Jim's recording box

Ver 0.99 10/2/2013

latest version always at http://jimlaurwilliams.org/projects/JimsSdRecorder/sdrecmanual.pdf

Introduction

These are the instructions for recording live square dances with Jim's custom MP3 recording device. It tells:

- How to turn on, connect, and adjust it
- How to harvest the recordings and recharge the device
- Some troubleshooting tips
- …and lots of gory detail about how it works and what's inside.

The design goals of the device are:

- Record at automatically optimized level with near CD quality, each tip in a separate file
- Be as portable, easy to set up, and foolproof as possible. It should *just work*.
- Easily last for a full day of recording without being touched

Latest production version

You should probably read most of this doc. The **Gory details** are mostly for the curious.

For the Very Impatient

- Turn it on (silver slider on side or small button on top of Sansa).
- Plug it in (back of Hilton, patch box, even speaker out; high level fine, low probably OK).
- While music is at normal level, turn knob so about half the LEDs are lit.
- Go dance your fool feet off.
- Come back at end of the day, unplug, turn off, take it home.
- Plug USB in, find new drive. Harvest files from RECORD directory. Recharge.

Old prototype

Connecting to the sound system

There are two common ways to connect to the caller's sound system:

- Patch boxes
- Direct connection to the amplifier

It doesn't matter at all whether Jim's box is turned on before or after connecting.

Patch boxes

The most common way to connect at higher level weekends is using a patch box. Because they take the actual signal that's going to the speaker, if it came out of the speaker, it should be on your recording.

While callers sometimes provide patch boxes since they know there will be people recording, square dance recordists usually carry them for their own benefit and for use by others. If you see one with empty connectors, it is almost always acceptable to connect to it.

Patch boxes have two very different kinds of connections:

Patch box from Keith Rubow

- **Speaker** connections, to connect the patch box "in series" between the caller's amp and the speakers. Almost always ¼" phone plugs. (On the right side in the picture.)
- **Recorder** connections to allow recorders to be connected to pick up the signal going to the speakers. (On top in the picture.)

Patch boxes typically have multiple recorder connectors of multiple types, and provide high and low level outputs, to work with various recording devices. Jim's box always works with high level input, and should work with low level as well. (If you can't get enough LEDs to light with low level, go to high!)

Both RCA and 1/8" phone jack recorder connections are often provided. RCA connectors are ideal for this application (according to the guy who chose to put one on Jim's box), but it's a good idea to carry an adapter to use a 1/8" jack in case there are lots of recorders plugged in or only 1/8" jacks are available. (Or people recording in stereo, despite the fact that there's only one channel of audio available, and inconsiderately hogging two connectors on the patch box instead of providing their own Y connector to feed their recorders from a single patch box connection.) There are some technical gotchas with 1/8" connections explained in the **Gory details** section.

Note: The amplifier should be powered off (or at the very least have the volume turned all the way down) when unplugging speakers and putting patch boxes in place! Plugging recorders into the patch box can safely be done at any time.

The patch box is electrically innocuous, and should never interfere with the speaker, tapping off only a miniscule amount of signal for the connected recorders. Many amplifiers have multiple speaker outputs, and connecting a patch box to an unused speaker output (with no speaker connected to the box) is also perfectly fine. If there are so many recorders that all the recording connectors are in use, it's perfectly fine to patch a second (or third) patch box in series with the first one: Unplug the speaker from the first patch box, plug the second into the first (where you unplugged the speaker), and then plug the speaker into the second patch box.

Long time recordist Keith Rubow sells patch boxes on his web site, **krubow.com**. There's also other hardware and software of interest to recordists and basement groups there, and lots of other good information. Details of how to make you own patch box are in the **Gory details** section.

Direct connection

The simplest connection when appropriate is plugging directly into the back of the caller's amplifier. ("When appropriate" means that there is a working connection with the right level available and no other recorders or other audio equipment – like an RF repeater for hearing impaired – are competing for that one connection, and the caller consents.)

The connector on the back of the amplifier will usually be an RCA female, so Jim's box will plug right in. Low level outputs are sometimes marked "Tape Recorder". If multiple levels are provided, they will sometimes be marked as high or low level. Here are the backs of some Hiltons:

While convenient for the recordist, connecting directly to the caller's equipment is a little touchier than using a patch box. It is virtually impossible to damage the amplifier with anything you plug into a patch box, but doing damage is slightly more likely by connecting directly. Because of the way it's designed, Jim's box is virtually incapable of doing any damage, but the perception is the issue. In any event, ALWAYS ask before connecting to the caller's equipment.

Etiquette makes connecting to the caller's equipment *while he is calling* completely unacceptable. Connecting to a patch box is quite different.

While it would be unusual to do so, Jim's box is designed to allow it to be plugged directly into a speaker output if no line level output is available. Obviously you'd need a suitable RCA to ¼" adapter.

It is possible that a line output is faulty on some amplifiers. If you don't get bouncing LEDs, you won't get any recording, so the case of a bad output should be pretty obvious, if surprising.

Note that on some Hilton models there's a "Music Monitor" output. You don't want that: you'll get the music, but no calling!

Turning on

Depending on model, turn the Sansa on either by sliding the spring-loaded silver bar on the left edge of the recorder up or by pressing the small button on the top edge at the right (not on the front). A thumbnail works well for the slider. The spring-loaded power slider has an additional position it "clicks" to at the bottom of its travel to help keep the player from turning on accidentally in a pocket. It's not relevant for us. Sansas with big squareish buttons on the front have the power button on top; ones with big round buttons have a power slider on the left side.

When you turn it on, the Sansa will display some logos and then go to the recording screen. You'll also see a brief sort of test scan on the LEDs (blue). See **Adjustments/Navigation** for more on the Recording screen. It doesn't matter what order you turn the parts on or connect to the amplifier.
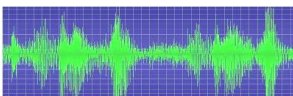
(If you have one of the early prototypes, turn the electronics on with the small slide switch on lower left corner of the PCB (red). Up is on. Later versions have no switch and turn electronics on/off automatically when Sansa is on/off.)
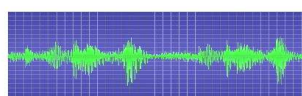
Setting the level

In audio recording, it's all about getting the level right. Jim's box accommodates a very wide range of input levels by providing a two-tier level adjustment and provides visual feedback to show when the level is good. You'll be more successful in recording if you understand the basics of how it works.

1) Input comes from the caller's amp – doesn't really matter how.
2) An initial "coarse" level control is provided by a knob which you must adjust manually. This accommodates any input level from mic to speaker. You set it at the beginning of a dance and forget it.
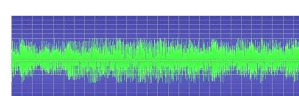3) An automatic "fine" level control is provided by the electronics in the box.

Widely varying signal from caller's amp ⇨ Initial manual "coarse" adjust sets right level for electronics ⇨ Magic electronic "fine" automatic level adjust gives uniform level for recorder ⇨ Sansa recorder

If this is the first session in this hall, you MUST set the level. To do this, you need normal dance volume music (or voice) from the caller's system. If it's before the dance starts (which is when you should be setting up) and the music isn't on, it's OK to politely ask the caller for some music for a level check. It just takes a few seconds.

With everything connected and powered on, while the music is playing, turn the manual level adjust knob in the upper right of the later models (lower right of the prototypes (green)) until about half the LEDs are lit most of the time. That's it – the automatic level control will take care of any variations from there. If you're recording at a weekend, once the level is set for the equipment in a particular hall, you shouldn't need to touch it for the rest of the weekend. That's really nice, because after the first session (where you set the level) you can come in early, set up and turn everything on and leave and be confident your recordings will be fine. To take advantage of that, be sure not to bump the knob as you're handling the device, pulling files off and recharging overnight. The knob is intentionally small and out of the way to help keep it from accidental adjustments. (There is no actual "knob" – it's just the shaft of the level control.)

You might want to put a small mark on the level control body so you can set the control for a particular combination of amplifier and patch box/direct connect. This is particularly useful if you record repeatedly from the same setup.

If the level is set too high, you may get distortion on loud peaks. If you set it too low you'll run afoul of the "noise gate" and soft parts of the audio will be lost. There's more on that important hidden feature in the **Gory details** section. But as long as you keep the LEDs half lit, everything should be fine.

Checking in on things

In general, you shouldn't need to check in on the recorder – *just working* is one of its design goals! But stuff happens, and you'll get some deserved warm fuzzies by checking occasionally.

The main thing to check is that the LEDs are still bouncing when the music's on. That catches most problems, including very unexpected things like somebody unplugging the patch box while you weren't looking (or were in another hall!) or unplugged your recorder from the patch box, etc. If the LEDs are bouncing, about the only thing that could go wrong is being out of storage on the recorder. And the 1GB in the recorder should hold about 23 hours of actual recording, so being out of storage is really unlikely.

On later production models, the LEDs are visible through the edge of the case. This lets you keep an eye on them without having to walk over and look down into the unit.

You can't see how much storage is left without taking it out of record mode. If you want to do that, exit the recording screen (not while it's recording something you want!) and go back to the Home screen by briefly pressing the power button (on side or top). It might take more than one press. Scroll down to the System screen, then go to RockBox Info. The amount of free storage is shown there (along with more precise battery info and other stuff). To get back to record mode, back out to the Home screen

(with left arrow or power button), scroll back up to Recording, and press the middle button. That takes you to the Recording screen, but you'll need one more press of the middle button to actually get into Waiting to Record mode. See **Adjustments/Navigation** for more detail.

To check on the battery when the display is dark, press any button on the Sansa. The first press only turns the display on and doesn't affect anything else. Look at the battery icon in the top left of the display. It shows the state of the large external battery which powers both the recorder and the electronics. (There's no longer a battery in the Sansa, so there's only one to check on.) The clearance is small between the top of the case and the buttons on the front of the Sansa, so you can usually just press the top of the closed case to press a button to light the display without opening the case. It's really pretty convenient.

That simple button press to check the display is also useful to make sure the recorder is really turned off. If a button press (other than the power button/slider) lights the display, it's not off!

You can play back the recorded audio (again only by going out of record mode). (The Sansa is primarily an MP3 player, after all!) Depending on the physical setup, it may not be possible to plug into the headphone jack on the right side. ☹ Back out to Home screen, go to Files -> RECORD (directory name) and you can see the files. Press middle button to play. Navigate with normal player buttons. Back out with power button. Unfortunately it's usually so loud in a square dance room that it's a challenge to use listening to the recordings between tips to get your warm fuzzies that it's all working. But if the LEDs were bouncing, it was fine. ☺

Shutting down at the end of the day

After the last session of the day, power the recorder off and unplug it from the patch box (or whatever it's plugged into) and take it home. Order of turning off and unplugging doesn't matter.

To turn the recorder off, briefly slide the power button up (or press the button on top if you have that type) to get back to the "Home" screen at right. If it was recording or timing out after recording, you may need to press the power button more than once to get back to the Home screen. From the Home screen press the button one more time and HOLD it for second or two until you see a brief "Shutting Down" message. The display will go dark and the recorder (and the rest of the electronics) are off. If you have a prototype with a slide switch on the printed circuit board, turn that off, too.
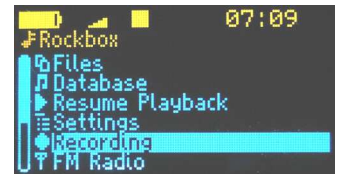
If there's more dancing tomorrow, try to not touch the level control. That way it will still be set correctly when you start up tomorrow. (If you do move it, the only cost is that you'll have to set the level again in the morning – not a big deal.)

The patch box usually stays connected to the caller's equipment over night.

Transferring recordings to the PC

Both transferring files from the recorder to your PC and charging the recorder are done via the USB connector on the upper left edge of the Sansa. You'll need a cable with "mini USB-B" connector. Plug the cable into the Sansa (being careful around the battery) and into the PC. It doesn't matter whether the Sansa is turned on before plugging in the cable. The Sansa should show up as a removable drive in the PC, and a USB plug symbol will show on the Sansa's display. You can't do anything else with the Sansa while the USB symbol is displayed.

That new drive will have a "RECORD" directory, which contains the files you've recorded. The files will have ugly but useful names like "R120220-215150.mp3". They always start with R for Recording. The first part is the date – here 2/20/2012. The second part is a timestamp – here 9:51:50PM. (Each field is 2 digits, year..seconds left to right.) As long as you keep the clock in the Sansa set correctly, you'll always be able to tell exactly when each recording was made. That has saved me several times.

At the default 96kb/sec, the files will be about 700KB/minute. A typical 10 minute tip will take around 7MB. You can copy the files to your hard drive and then delete them from the recorder, or save a few clicks and Move rather than Copying them. As with any removable drive, you should eject or unmount or "Safely Remove" the drive before you unplug it.

In practice, you'll probably just leave the recorder plugged in to recharge it for the next day.

Charging and the battery

The recording box charges through the USB connector. Just plug a "mini USB-B" cable into the recorder and into any USB charger. A "wall wart" or a PC with a USB port will work fine. If you've just dumped the files to your PC, just leave the recorder plugged in. You can't overcharge it, so leaving it plugged in overnight is fine. The Sansa will get a little warm during charging – that's normal.

The battery icon in the upper left corner of the display will show both how full the battery is and that it's charging by starting with the battery level (more yellow is more charged) and then animating the yellow moving to fill the battery up. There's also a little icon of a plug just to the right of the battery when it's charging. When it's all or almost all yellow and there's little or no animation it's fully charged. Depending on the charger, a near empty battery will take several hours to charge. To check the state of charge more accurately, unplug the USB cable (either end), go to the home screen, System, Rockbox Info. While I've seen it at 100%, I usually can't get it above maybe 93%. I'm not sure why.

To charge from a computer without having the Sansa go into USB mode (visible as a drive to the computer, and a USB plug symbol on the display), hold the Select button (very center) before and while you're plugging it in.

Update 10/2/13: There was a problem with the code that manages the internal battery charger. A timer designed for backup protection against overcharging was set to trigger too soon, so the battery wouldn't fully recharge. Unplugging the recorder and plugging it back in would reset the timer; a few cycles of that would fully charge the battery. The code has been modified so it can fully recharge in one shot.   If you have the old code and would like to upgrade, drop me a note and I'll send the new code and instructions on how to upgrade. (It's pretty simple.)

While initial testing showed the recorder would run for more than 24 hours on a fully charged battery while continuously recording, I had one recorder run out of battery part way through the evening session at a weekend, violating one of the basic design requirements. I'm still looking into this. I may put larger batteries in my recorders and ones I make in the future. One possible workaround is to charge the recorder while it's running. There are lots of cheap battery powered USB chargers on the market for recharging phones, etc on the go. I've tested that these devices will recharge the recorder, and will not disrupt anything even if plugged in at a dance while the recorder is recording. I now carry one that uses two AA batteries in my case for emergencies.

Battery warning

The lithium-poly battery (large shiny silver thing on the left) has very good capacity and is very light weight, but is slightly fragile. It's fine to touch it, but don't poke it with anything sharp. While very unlikely, if it ever becomes puffy instead of its normal flat shape, take it outside and put it in some kind of fireproof container. It is unstable when puffy and could spontaneously catch fire. Don't use the recorder any more with that battery.

If the battery ever needs to be replaced, any lithium-poly battery of 850 mA-hr capacity or larger that will fit can be used. Do not try to use any other type of battery. The original came from SparkFun, part # PRT-0031, though there's nothing magic about that battery. If you use something smaller than 850 mA-hr, everything should still work fine, but it may not hold up for a whole day's recordings any more. Don't use anything below 350 mA-hr, as that's what the charging circuit is set for. If you have to unsolder/resolder the battery, be very careful not to sure the leads. Even a momentary short may cause a protective fuse-like circuit in the battery to render the battery unusable.

If you have any problems with the battery, let me know.

Post processing

The MP3 files you get from the recorder will be pretty usable as is. You'll be able to tell from the file sizes which files actually contain tips and which are just the caller getting folks to square up, or saying they need a couple in square 4. But if you want to provide the best experience for your tape group – or other tape groups with whom you've traded recordings – you may want to clean up the recordings a little. Here are some comments on editing your recordings.

There are lots of good audio editing programs, and you'll probably want to get familiar with at least one. I bit the bullet and paid my $50 or so for a copy of Goldwave many years ago. It's still my editor of choice, if only because I've gotten so comfortable with it over the years. Cheaper and still very good is the open source Audacity. And I think there's still a copy of the old free version of Cool Edit on Keith Rubow's site.

One of the first things I used to do was normalize the volume so I didn't have to run over and adjust the volume from one tip to the next. But with the current software and hardware in these recorders, all the recordings come out so close to the same level (with peaks around 90%) that I don't even bother any more.

I do still listen to the beginning of the tip and trim the initial music and chatter so there's maybe a second and a half of silence, a couple of bars of music (starting at the beginning of a phrase) and then "Bow to your partner…". When the caller is talking over those last few seconds, I've even been known to go back earlier in the recording, copy a clean version of those bars and edit them in so it's a nice clean start. But that's pretty nutcase.

Then I skip to the end and fade out over a second or two after the caller's final dancing words. I've found some callers just abruptly cut off the music, leaving me little to work with, while others (Todd comes to mind) almost always leave the music on and fade it out gradually themselves. I'll leave a couple of seconds of silence after that and trim off whatever's left.

After editing, I choose to save my final recordings at 44KHz and 80 Kb/sec. I've set the recorder's defaults to record at 96Kb/sec, providing just a little higher quality so it's still good after any editing I do. Others are comfortable at lower quality in return for file sizes that are less than half what mine are. It's just personal preference. And if you don't like the 44 KHz-96 Kb/sec recording parameters, you can go to the Home screen, Settings, Recording Settings and set the Frequency and Encoder settings to whatever you'd like.

Other edits I've been known to make are to cut out whole sequences – from Home to Home – when I know there's an error in the sequence. More commonly, if I know the caller is talking a lot – usually trying to correct individual squares – I'll listen carefully and cut out the yammering - while being very careful to not cut out any real calls! - so we don't have to stand around as much. I'm especially likely to do that if it's otherwise a really hot tip and the talking really breaks the flow.

As a dancer, I find it extremely jarring when the beat of the music jumps, so when I do cut out whole sections I'm pretty careful to at the very least keep the beat intact. Usually I'll also try to cut out whole bars, so if the cut starts on the 3rd beat, I'll try to end it on the 3rd beat. And sometimes if I'm cutting out a whole lot I'll try to cut so it's not only an integral number of measures, but in the same key. That's harder to pull off. Anyway, you'll have lots of opportunity to sharpen your editing skills ☺. But at least try to keep the beat going smoothly.

The MP3 file format supports embedded metadata *tags* – like artist, album, genre, year, ratings, comments. I encourage you to take advantage of these "ID tags" to help organize your recordings. There are several free tag editing programs,

and Keith even has one he wrote on his site. Once you have your files tagged, it's easy to pull up, for example, everything by a favorite caller.

Directory structure preferences are even more personal than metadata tags. But let me share one insight it took me years to figure out. As I'd record a couple of halls at a weekend, I used to save files the way I pulled them off my recorders: Here's Friday night, with a subfolder for A2 and another for C1. Here's Saturday night, with sub folders for the levels. But when I'd go to put something together for our basement group – or to trade with another weekend recorder – Friday vs Saturday didn't matter much, but the level did matter. So now my top level directory structure is by level. After my cleanup edits I include the day and caller in the file name, leaving everything for one level at that weekend in one directory. If you have multiple levels of recordings, you may find that a useful way to store them. (And you do record in the hall for the next level up – just in case you move up – don't you?)

Possible problems

Here's a list of the most common problems I'm aware of with this setup.

Sansa not recognized by the PC

Apparently when the battery is low, the Sansa can fail to communicate its identity to the PC. The solution is to charge the battery. A separate wall wart charger should be fine, or holding the Select button as you plug it into the PC to charge so it doesn't try unsuccessfully to establish a data connection to the PC should work.

One instance of a variation of this problem has been reported where after failing to communicate with the PC, the Sansa "hung", with the USB symbol on its display even when unplugged from the PC. It was completely unresponsive, and could not even be turned off. (This should never happen.) The solution was to just leave it unplugged and let the battery drain completely. When it finally shut down due to a dead battery, charging it back up (holding Select if charging from the PC) brought it back to normal. Please let me know if you ever see this!

A slightly similar problem was reported by one user, where the Sansa would be recognized, then not recognized, etc, making it hard to transfer files. This turned out to be a bad USB cable. It worked fine with a new cable.

Sansa appears dead, won't turn on

I saw this once, and one user reported significant problems with it. He finally had to resort to putting a normally closed push button in series with the battery to provide a hard restart. I feel awful that anybody would have to do something like that! I'm considering putting a real switch in, although if you turned it off the Sansa would forget its very convenient time/date stamp.

Hum from other AC powered recorders

The recording box neatly sidesteps many hum problems by being battery powered and completely isolated from the AC line. Unfortunately, it is still possible for others' recorders which are powered from the AC line to inject hum into the patch box in such a way that it gets into your recordings. There's not much you can do about it except ask the other guy to try reversing his AC plug, or perhaps using a separate patch box plugged into a different speaker jack. Or try to get him to get a nice battery powered recording setup so he won't mess others up.

I've even seen a case where the caller's laptop power supply was the culprit. That hum was soft enough that it wasn't a problem at normal dance volume, but was noticeable at quiet times.

"The Hum Problem"

Hum (or other constant noise) - possibly introduced by the caller's laptop or others' AC powered recorders or just a bad power supply in the Hilton itself - can create another problem. If the hum/noise is fairly bad, there may be enough even when the music and voice are off between tips to keep the Sansa from deciding it should stop recording. This costs you three ways:

- You'll just get one huge file rather than the usual nice one-tip-per-file. You'll have to split it up with post processing.
- Because the recorder never shuts off, you'll fill up the storage on the recorder faster than you expect.
- Because the recorder draws more current from the battery while recording than while waiting to start, your battery will drain faster than expected.

The good news is that the 1GB of storage on the Sansa provides more than 20 hours of actual recording. You can't possibly run out in one day, and even if you put a whole weekend on the recorder without dumping the files at night you're still probably OK.

There are two ways you can try to tune thresholds to get your recorder to shut off between tips despite the hum. Both are studies in brinksmanship – good luck.

- Lower the input level with the manual control so the hum is below the noise gate threshold. Read about the **Noise Gate** in **Gory details**. Using the level and timeout bars on the recorder, turn the manual level control down so the recorder stops despite the hum. With that level setting, when the music comes back on make sure you have at least a couple of LEDs lit all the time. You can definitely get the recorder to stop this way, but you might or might not have to turn the level so low the soft parts of the music fall below the noise gate.
- Raise the "stop below" threshold on the recorder. Read the RockBox manual. Maybe you can find a setting that will turn the recorder off with the hum present and still not misbehave. If you try this you'll likely start the 'stop recording timer' sometimes when there's still real music, so you might want to increase the 'stop below…for at least' time as well. If you do that, set a matching value for Presplit Gap.

Level setting problems

See the **Noise Gate** section in **Gory details** for more information on subtleties of level setting. Bottom line for 95% of all cases: Make sure about half the LEDs are lit all the time and everything will be fine.

Patch boxes without separate dividers per channel

If you see one of Keith Rubow's big black patch boxes, you're probably safe from this, since his boxes are designed properly. But especially if it's some other kind of patch box, there are designs of what's inside the box that make it so one particular type of recorder input (very low impedance) plugged into one jack can drop the level to all the other jacks so low that they can't record. (The guy with the 'bad' recorder may be fat dumb and happy and not know anything's wrong, since his recordings are still fine.) If you set your level and he plugs in later, even though your recorder could deal with the lower level with a different setting of the manual control, you still lose your recordings. Fortunately, this is rare. It is, however, one of the cases that makes checking in on your recorder occasionally worth considering.

Caller laptop messes up levels from direct outputs

There are lots of different ways Hiltons are wired up, and lots of ways callers have to plug their laptops in to get music to play. I've lost all tips for a particular caller while connected directly to the amp, though recordings of other callers on the same Hilton and recorder were fine. If you use a patch box rather than plugging in directly, this problem can't happen to you. If I'm recording where there are multiple callers with different laptops, I'll use a patch box even if I'm the only one recording just to avoid this problem.

Button presses through the case

It is possible to press on the top of the case in such a way as to press buttons on the Sansa. Depending on exactly which buttons were accidentally pressed, this might take the recorder out of record mode. I've considered making some kind of raised form around the buttons to avoid this, but it's never actually happened. A single button press is never a problem – that one just lights the display up for a while. But certain further sequences of presses while the display is lit can be a problem.

Problems with 1/8" plugs and jacks

There's information in the **Gory details** section on subtle incompatibilities with 1/8" plugs. It's a messy problem, and that's part of why my recorder boxes have RCA plugs.

Adjustments/Navigation

There are lots of settings that can be changed in the recorder. The defaults are what I've found to be about ideal for square dance recording, and you probably won't need to change anything. If you find you do need to change something, please let me know so I can consider changing the defaults.

Since the firmware in the recorder has been changed, the main user manual is NOT the one from Sansa. What you want is the RockBox manual. You can download the latest version (currently about 200 pages) here: http://download.rockbox.org/daily/manual/rockbox-sansaclipv2.pdf. Since the software is constantly under development, some details may be different in that manual, but it will still be your primary guide to navigating all the screens and settings in the recorder.

The two main screens you'll need to be familiar with are the Home screen (where pressing the power button will turn the recorder off, described earlier) and the Recording screen. Here are some details about how the Recording screen shows what's happening:

Actively recording

When the recorder is actually recording, you'll see a ROUND spot at the right side (green). You'll also see the current record level shown by bouncing bars (pink) just above the round spot. The size (so far) of the current file is also shown.


Stopped – Waiting to Record

The recorder starts (making a new file) when it hears music, and stops when the level drops below some threshold for a while. When it's stopped and

waiting, you'll see a SQUARE spot on the left side (red), and the Size indication is replaced with "Pre-Recording". (It is actually recording, so the file will start with a few seconds of whatever the input was BEFORE the music got loud enough to be detected. It's magic.)

Timing out – About to Stop

The music level coming in must remain below a threshold for 15 seconds before the recorder closes the current file and waits to start another. It continues to record normally during those 15 seconds. This allows brief periods of silence without splitting the tip into multiple files. When the recorder is in this state – input below threshold, but 15 seconds hasn't elapsed yet – you'll see the rectangular bar between the round and square spots filling up, from right to left (tan). If the music picks up again before the timeout bar is completely filled, the timer is reset (bar emptied) and recording continues until the level drops below the threshold again. (The 15 second value can be changed in Settings->Recorder->Trigger->Stop below <>for at least <> seconds. See the RockBox manual. If you change this, change the Presplit Gap to the same value.)
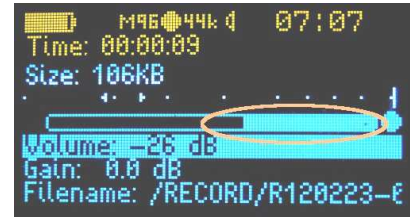
Recording screen – NOT recording

There's one other fooler state the recorder can be in you need to know about – because from this state IT WILL NOT RECORD ANYTHING! If the display says Pre-Recording but there is no square spot on the left and the empty timeout rectangle is missing (blue), it WILL NOT RECORD – even though the level indicator bars may be bouncing and it says (incorrectly!) Pre-Recording. Pressing the small middle button on the Sansa will change from this usually undesirable state to good old Waiting to Record, with the square STOP spot on the left and the timeout bar shown.
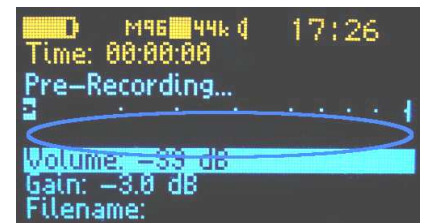
The recorder will not normally be in this state. When you turn it on, it should go straight to Waiting to Record. But if you've gone back to the Home screen and pressed the middle button to get to the Recording screen, you will be in this state and need one more button press to get to Waiting to Record.

Volume vs Gain settings

Wizard stuff - you shouldn't need to touch this. If you want to change the level of what's recorded in the MP3 file, the setting you want on the Recording screen is Gain, not Volume. Use the up/down navigation sections of the big button on the front to highlight Gain, and the left/right sections to increase/decrease the value. The Volume setting is for current playback volume from the headset jack, not record volume.

Setting Date and Time

Since the filenames created by the Sansa very helpfully include the date and time, you want to make sure the Sansa clock is set right. First, get the RockBox manual. That's your main source of detail about how to navigate and operate your Sansa running RockBox.

Use the power button to back out to the Home screen. Go to Settings->Time & Date. You should be able to figure it out from there.

Restoring factory defaults

If you play with the settings and get things so messed up you want to start all over, you can reset to factory defaults. ("Factory" means "Jim's" here.) Look it up in the RockBox manual.

Gory details

The Noise Gate and 3.5 mm Connector Issues sections below contain some pretty useful insights. The rest is only for the terminally curious.

The Noise Gate and setting the level

The electronics in the box implement an Automatic Level Control. It senses the level of sound coming in and tries to keep a fairly constant level going out to the recorder. This is great, but there's a problem: As the input level drops lower and lower, the gain is cranked up more and more, looking desperately for some kind of signal. Eventually there's more noise (typically a hiss of thermal noise) than useful input, and all we get out is useless, but loud, noise.

This is particularly bad for a setup like this one where we depend on the input to the recorder dropping below some threshold to know when to stop recording. Fortunately there's a feature in the ALC chip called a "noise gate" to address exactly this. When the input drops below a certain point, the chip STOPS turning the gain up and in fact turns it down. Input below this "noise gate" threshold level is essentially muted.

When everything is adjusted properly, this is ideal: The only time the input drops below the noise gate threshold is when the caller turns off the mic and music between tips. The ALC delivers essentially silence to the recorder, making it very easy for the recorder to sense when to stop recording.

The problem comes when things are not adjusted properly. When the input level to the ALC chip – which YOU control with the manual level control – is set too low, soft parts of the music and/or voice fall below the noise gate threshold and are effectively silenced. This obviously makes for undanceable recordings.

The only way you know how to adjust the manual level control is by looking at the LEDs. I've tried to calibrate those LEDs so the noise gate threshold occurs just below when the lowest LED no longer lights. So if at least a couple of LEDs are lit all the time, you've probably set the level high enough to avoid the noise gate. Obviously the more LEDs lit the safer you are from the noise gate. Unfortunately, if the level is too high, you'll get distortion on the loud parts. I've also tried to calibrate the LEDs so you don't hit distortion until the top LED is lit.

So we're back to the original statement: Set the level so about half the LEDs are lit, and you should be safely above the noise gate and below peak distortion. You'll also be about in the middle of the ALC range, so it will be working for you as well.

If you're really curious about the noise gate behavior, if you can plug into the Sansa's headphone jack (the level control blocks it in some older boxes), you can listen to what goes to the Sansa. Play some music into the box and turn the level control down so one or no LEDs are lit. You'll hear the noise gate kick in by having all but the loud parts silenced. This is pretty enlightening about the noise gate's behavior. Even if you can't get to the headphone jack, you can use the level indicator bars on the Recording screen in place of listening to get some feel for the noise gate. (If the jack is blocked and you're really, really motivated to *hear* the effect, the audio into the Sansa is on the rightmost of the 3 wires going into it. Ground is the leftmost.)

3.5mm (1/8") TS/TRS Connector Issues

Background

(Sorry, this is a long one.) The ubiquitous 3.5 mm "headphone" plug is a great little connector. Unfortunately, for connecting recording equipment, it can get you in trouble a couple of ways. To understand the problems, let's start with the connectors themselves (and their variants). It turns out the mechanical details matter. (These comments apply equally to the larger ¼" phone plugs/jacks, but they're almost never used for recordings like ours.)

There are two genders of these connectors:

The male, or "plug" looks like this. It can have two or three conductors, separated by small insulating bands. (We'll ignore the rare 4 conductor TRRS versions here.) The main shaft of the plug is called the Sleeve and almost always connected to Ground. The very end conductor is the Tip. The third conductor is connected to an isolated metal ring called (duh) Ring. If there are only 2 conductors, the overall length is the same, but the insulator between Ring and Sleeve is absent and the Sleeve extends to include where the Ring would be. The 3-conductor variety is referred to as a TRS (Tip, Ring, Sleeve); the 2-conductor a TS.

The female, or "jack" looks something like this TRS version. I've inserted a male TRS so you can see how the contacts work. You can just barely see the black insulating band between the Ring and the end of the Sleeve. The jack has a cylindrical tube into which the plug is inserted. Longer is better for the tube, as it provides mechanical alignment with the spring loaded contacts for the Tip (and Ring if present). The tube is often metal, as it is here, to provide contact with the plug's Sleeve. Note that if a 2 conductor (TS) plug were inserted, the jack's top contact – intended for the Ring – would touch the longer Sleeve of the plug.

The problematic version of the jack is designed for 2 conductors. (Sorry, no picture.) There's no Ring contact, so the jack's metal tube is made considerably longer. If a TRS plug is inserted into one of these problematic jacks, the plug's Ring is shorted to its Sleeve by the jack's longer tube.

The problems come when a TS plug is inserted into a TRS jack, or a TRS plug into a TS jack. They're all physically the same size, and you can't easily tell a TS from a TRS jack.

If you're the recordist, you have a couple of possible ways of wiring your plug. If you're making a patch box, you have a couple of ways of making that. There is one "best way" to wire your plug and one for the patch box maker to wire his jacks. Let's look at the wiring possibilities and how the combinations work or get us in trouble. Sleeve on all is always Ground.

Plug for the recorder

There are four ways you can wire the 3.5 mm plug you'll plug into the patch box:

    (A) Mono recorder input with normal mono (TS) plug. Simple and obvious.

    (B) Mono recorder, stereo (TRS) plug, using only Tip to go to the recorder. Ring is not connected.

    (C) Mono recorder, stereo (TRS) plug, Tip and Ring are connected to each other and to the recorder.

    (D) Stereo recorder, stereo (TRS) plug, one channel to Tip, other to Ring. (Note that making stereo recordings of square dances is inefficient: It costs twice as much storage to save two identical copies of the one and only audio stream compared to recording in mono.)

Jacks for the patch box

There are five ways to wire 3.5 mm jacks on a patch box:

    (1) A proper (short tube) mono jack, with signal to Tip.

    (2) A problematic long tube mono jack where the jack's tube touches both the plug's Sleeve and Ring.

    (3) A stereo (TRS) jack with signal only to Tip, and with Ring not connected.

    (4) A TRS jack with Tip and Ring connected together and to the signal.

    (5) A TRS jack with Tip and Ring each connected to a separate, isolated copy of the signal.

How they play together

Your (A) plug works with (1), (2), (3), and (5). If the patch box has setup (4), its Ring will touch your Sleeve, shorting out the signal, so you get nothing. If it has setup (5), one of its channels (connected to Ring) will be shorted to ground, but that shouldn't hurt the box or your signal.

Your (B) plug works with everything. It's a winner (if not an obvious way to do it). You'll probably have to wire it up yourself.

Your (C) plug works with (1), (3), (4), and (5). If the patchbox has setup (2), its long tube touches your Ring, shorting your signal to ground, and you get nothing.

Your (D) plug gives you signal to both your redundant, wasteful channels for patchboxes with setups (4) and (5). You will at least get one good channel with patchboxes set up with (1), (2), and (3).

The patchbox maker's best choice is (5). Unfortunately, they're not all made that way. ☹

Stereo-to-mono adapters

No discussion of stereo/mono connectors would be complete without a warning/rant about using "Y" connector stereo-to-mono adapters to combine the two channels of a stereo output to get a mono signal. This might happen if you were using the (stereo) output of your laptop or MP3 player to drive a mono amp (like music in to a Hilton) for a tape group **and didn't want to blow out the audio stage in your laptop/MP3 player**. Of if you were using somebody else's laptop/MP3 player **and didn't want to blow out the audio stage of *his* laptop/MP3 player**. (This problem occurs with any connector types – not just 3.5 mm. But the availability of 3.5 mm adapters like the one below makes it easy to do damage.)

Adapters like the one on the right look like they would do just what you want. This one's marked "M" to indicate that the female side is mono. The versions with an RCA female are just as bad. DON'T PLUG THIS INTO THE AUDIO OUTPUT OF YOUR LAPTOP. The wiring inside directly connects the Tip and Ring of the plug (and provides it on Tip of the jack). This directly connects the left output to the right output of your laptop. You NEVER want to connect one output to another output! If both channels are putting out identical signals, it's not harmful. But in typical stereo music, at times one channel is going positive while the other is going negative – and you've connected them together to fight it out! This is just asking to blow out the output amplifiers, especially if the level is turned up. Of course it doesn't cause damage *every* time, so you might get away with it for a while. Feel lucky?

The only safe way to combine the channels is to put a resistor (maybe 8-30 ohms) in series with each output and connect those resistors together with their junction going to the mono next stage. Unfortunately, these are hard to find already made up. If you must drive something from a stereo output you care about, find an adapter that splits Tip and Ring of the 3.5 mm male to separate connectors and lets you connect to only ONE of the laptop's output channels. Then you're in good shape. (Of course if you're actually trying to mix the two channels of a stereo signal, the two resistor setup above is the only simple safe way to do it.)

The adapter shown above is completely legit when used the *other* way – to take a mono signal and replicate it to both channels of a stereo *input*. Just don't try to combine two channels with it!

Recorder hardware

The recorder hardware is a used commercial MP3 player/recorder from Sansa. Two models are used (depending on what's cheap on Ebay) – the Clip and the Clip+. The Clip+ (squareish buttons) has a socket for an additional Micro SD card, but that's not used here. While the recorder is described as 1GB, the actual devices may be 1, 2, or 4GB, and may be any color (depending on what was cheap/available on Ebay).

The recorder hardware is modified by opening it up, removing the battery, replacing the microphone with a wire for an input connection, and gluing in a small PCB which provides mechanical mounting and electrical connection for 3 stout wires that come out of the back of the case. Those provide V+, Gnd, and Signal In to the recorder, as well as part of the mechanical mounting. Some 4-40 nuts are epoxied on the back to complete the mechanical mounting.

Recorder software

The firmware in the Sansa is replaced by a lightly modified version of the open source audio player/recorder software called Rockbox (rockbox.org). This software, which has been ported to a surprising number of consumer devices, removes artificial limitations imposed by the manufacturer's original firmware, allowing the device to do anything it is physically capable of (and for which some volunteer developer saw fit to write code). In particular I've taken advantage of the much more flexible mechanisms Rockbox provides for automatically starting and stopping recording based on sound level coming in to put each tip in its own mp3 file. I've also taken advantage of the ability to have it boot up in any mode I choose. That lets it start up in recording mode, reducing the number of steps the user is required to perform, thus reducing the opportunities for the user to screw up his valuable recordings ☺.

Other electronics

The electronics on the small PCB starts with a log taper pot providing an input attenuator to accommodate signals up to moderate speaker level. A wide range automatic level control is provided by an Analog Devices SSM2167 microphone preamp to keep recordings at a constant level for tape group dancing. The 2167's ALC feedback voltage drives the LED bar display through an LM3914 so the user can use the input attenuator to set the level to the middle of the 2167's usable range. The only clever thing is taking advantage of the DC voltage the Sansa puts on the internal microphone lead to turn on a MOSFET when the Sansa is on, powering on (and off) the additional electronics without requiring the user to remember to flip an additional switch. One more step to protect the user from himself.
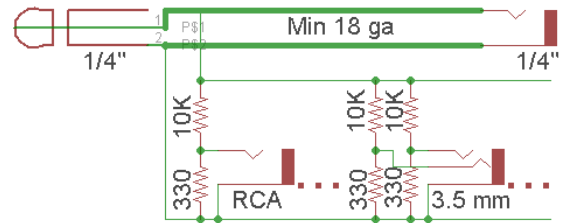
Patch boxes

There's nothing magic about patch boxes. The requirements are two ¼"
phone connections to go in line with a speaker, however many of whatever
kind of jacks you want, and a handful of resistors. My preference is for plugs
on pigtails rather than jacks and separate wires, as in this minimalist patch box
I can always find room to stuff in my recording bag. It's mostly for my own
use, but provides a couple of extra jacks for others.

The speaker connections MUST be heavy gauge wire, well soldered, and very
robust. You *really* don't want *your* patch box to cause a speaker to fail in the
middle of a dance.

Each recording jack gets its own voltage divider across the speaker
leads. The 10K/330Ω values shown are appropriate for "high level"
outputs. As mentioned above, for 3.5 mm jacks, use a stereo jack
with separate dividers for Tip and Ring. Resistors are cheap.

DON'T use a single voltage divider and parallel all the jacks! If one
user happens to have a shorted cable – or a recorder with very low
input impedance – it will kill the signal for everybody else! And if he
plugs in later in the day, the others might have tested their recordings and walked away believing everything was OK –
only to have nothing after some point in the day! With separate dividers, nobody can interfere with anybody else.

Patch Box Wiring - high level out

…end…