DIFFERENT DRUMS

Creating Drum Sounds On Analogue Synths

Published in SOS April 1996
Printer-friendly version

OK, you've read the interviews; Vince Clarke, the Human League, 808 State and many others all obtain their drum sounds from analogue synthesizers. And, of course, Roland's famous TR808 and TR909 drum machines are just analogue synths anyway. So, how exactly do you coax killer drums from your hoary old monosynth? TOM CARPENTER offers some guidelines...

Today's dance music is dominated by the sound of Roland's TR808 and TR909 drum machines -- whether sampled from the original unreliable machines or generated directly by the real thing. But many people, particularly those who only have access to the sounds in the form of disks for their samplers, forget that these sounds were originally generated by analogue sound generation circuitry not so different from that found in analogue synths. In fact, it is possible to generate a wide variety of drum sounds using even fairly simple monosynths. Most of Kraftwerk's percussion sounds were generated in this way, and the music of Erasure's Vince Clarke represents an even more extreme example. The 'drums' on his last three albums have been produced exclusively from synths, with not a Tibetan finger-cymbal sample in sight -- and does anyone recall that the rhythm track on his 1982 smash hit 'Only You' was all created on a Sequential Circuits Pro One monosynth? Some of his hard-won drum sounds have, of course, become generally available to the public via his *Lucky Bastard* sample CD, released with the aid of sample CD merchants Time & Space two years ago.

Why these sounds are so effective is hard to say, but many people (pioneering rap producer Arthur Baker is one example) believe that it is the synthetic nature of these sounds that makes them ideal for the creation of all-pervading rhythm tracks. Some contend that as these sounds are generated exclusively by analogue electronics, they often contain many frequencies unobtainable from acoustic drums, allowing them to cut through a mix that bit more effectively.

Whether this is true or not, there is no denying the hold of the analogue-generated drum sound on modern dance. But if you've got access to an analogue synth, why stick with the all-too familiar sounds of the Roland TR-series, or Vince's samples? Why not create your own? With a little careful programming, it can be done.

IN GENERAL

Analogue drum machines have miniature synths built in for each sound they produce, and each of these synths has the basic elements needed to produce each sound. Some sounds may only require a noise source, a voltage-controlled amplifier (or VCA) and a simple envelope generator (or EG), with just a decay setting, to produce their sound. More complex sounds might involve a couple of oscillators, filters, and EGs.

Because drum sounds are generally more complex than a straightforward synth sound, the more sound-shaping modules your synth has (ie. oscillators, filters, ring modulators etc), the more wide-ranging and 'realistic' your drum sounds will be. Of course, you do not want your new sounds to be *too* realistic; just enough so you can recognise your sound as a snare, kick, or hi-hat-type sound, for example.

How successful you are depends to a great extent on the spec of the synths at your disposal. You may find that you are able to create reasonable approximations of drum sounds, but which lack the 'oomph' of (say) the Roland TR-series sounds. In this case, don't be afraid to mix the sound you've created with a low sample from one of the TRs -- or even an acoustic drum sample! After all, provided you don't swamp your sound with the sample, you'll still be using something different from what most people can produce.

Generally, decent kick drums are easily achieved. Snares, on the other hand, are very hard to obtain, and often sound the weakest. Here it may be necessary to add analogue and real snares together, to add extra snap. Most percussive sounds (such as metallic percussion and white noise sounds) sound reasonably alright on their own, but external effects such as reverb, delay and flange will help them sound more effective.

BEFORE WE START...

In this article, I have described a little of the theory behind each common drum sound, so you can try and duplicate the results on your own synth. Ideally, you will need an analogue synth with two oscillators, a ring modulator, a white noise generator, and high-pass and low-pass filters (HPF & LPF) which you can send into self-oscillation, in addition to the usual LFO and Attack-Decay-Sustain-Release EGs (preferably independent ones for the filter and amplifier). Some of the descriptions are referenced to example patches for specific machines, including the Roland SH101 (use anything more basic than this one-oscillator synth and you will find yourself very limited), the aforementioned Sequential Circuits Pro One (the next step up, with two oscillators), and the Korg MS20, which is extremely good for creating a wide range of sounds, with its two oscillators, ring modulator, HPF and LPFs. You should be able to broadly replicate these examples on other analogue synths -- though some tweaking to the parameters suggested here may be necessary.

1.00: KICKS AND HITS

Kick drum sounds are created by one or a combination of the following two methods:

• Using a 'pulse hit' or 'thip' sound (of which more in a moment). Turn your resonance up high (though a touch down from maximum, so the sound is more of a thud than a 'thip'), set the filter cutoff at zero, and use your EG to modulate the cutoff in a quick downward sweep. For the sound to work, you really need a synth with a filter that can be sent into self-oscillation. This includes most monosynths, such as Moogs, the Sequential Circuits Pro One, the Roland SH101 and MC202, and the Korg MS20. The filters of Yamaha CS monosynths, the Roland SH09, and most polysynths tend to be a bit too weak to create decent kicks and thips.

• Using a low note (a sine waveform works best) with a short decay time. Most monosynths can produce kick sounds using this method. For the best results, try a mixture of these two sounds. The SH101 produces some excellent results (see examples 1.11-1.13), as does the Pro One (see example 1.2) and the MS20 (example 1.31).

Having mentioned the 'pulse hit' as an important component of decent kick sounds, it's worth pointing

out that this superb sound (with resonance at maximum this time) has become an essential percussive staple in electronic music of any kind. Kraftwerk's albums, among millions of others, are littered with them. See examples 1.14 and 1.32 for some typical pulse hits on the SH101 and MS20.

2.00: SNARES

Most analogue drum machines create snare sounds using white noise (run through an HPF to crispen the sound, making it snappier and less bassy) together with two oscillators at different pitches. The whole signal is run through a VCA modulated by an EG. Some analogue snares are more complex, using individual VCAs, filters and envelopes for each of the oscillators and the noise. By balancing the levels of the three sound sources, together with the pitch ratio of the two oscillators and the HPF cutoff frequency, different snare drum tones can be created. By sending the HPF into self-oscillation, you create extra resonances, thus mimicking real snares, which produce different harmonics depending on skin tightness.

Ideally, a two-oscillator monosynth with a noise generator is needed. The MS20 (see example 2.1) or Yamaha CS15 are ideal, as they meet these requirements, as well as having an HPF to filter the noise. The SH101 and Pro One are only good for noise-based snares, due to the lack of an HPF. Nevertheless, these are worth trying (see examples 2.21-2.22). If your monosynth only has one oscillator, try sending the filter into self-oscillation (with no envelope sweep) to produce an extra tone, and mix this in. If you have a sweepable EQ available, try boosting the mid-range and cutting the bass end to add more 'snap' to the sound. As mentioned above, punchy snares can be tricky to create on basic monosynths, so you may wish to add another snare sample (fairly low in the mix) to anything you create.

3.00: HI-HATS, CYMBALS, AND METAL PERCUSSION

Creating great analogue hi-hats and cymbals like those on the TR808 is tricky with monosynths. To quote the TR808 service manual, the metal sounds are created by 'the combined square wave outputs of six Schmidt triggers...'. So, forgetting that, I usually resort to the good old ring modulator to create metallic-sounding hi-hats. Create a high-pitched, discordant metallic sound (it's not too tricky with a ring modulator!), and set up a slow decay but a quick release time on the VCA EG. Quick, staccato notes should give you the closed hat sound, and long, held notes the open sound. Experiment by adding some HPF-filtered white noise to the sound if it's not quite right.

For all of these parameters, the MS20 is ideal (see example 3.11). Of course, if your synth hasn't got a ring modulator, like the SH101, you'll have to fall back on pure noise hi-hats (see example 3.21), or find another way of creating a similar effect (see example 3.22 for an SH101 trick along these lines).

Convincing cymbal sounds are almost impossible to create -- even Vince Clarke has given up! Having used samples to get around the problem at first, he now avoids the use of cymbals in his compositions altogether. If you don't wish to go to such extreme lengths, and don't mind unconvincing cymbal sounds, try patches like the hi-hats, but with a longer decay and more HPF-filtered noise (see example 3.12). All of these sounds respond to phasing and flanging effects superbly, another trick Kraftwerk exploited to the full.

4.00: HANDCLAPS

The ubiquitous TR808 clap is generated from analogue circuitry; but sadly, creating your own sounds from a monosynth alone is very difficult, as the TR808 clap is more complex than it appears.

The sound can be viewed as the result of lots of people clapping nearly all at once, and is actually produced on the TR808 by passing white noise through a band-pass filter. Two envelopes are used on a VCA; one is a repeating sawtooth-shaped envelope, to produce the 'lots of people clapping nearly all at once' sound, while the other envelope has a long decay to produce the reverb. Using this principle, a usable sound can be created on the MS20 (see example 4.1), but most monosynths are not flexible enough to make the sound work unaided. At a push, several bursts of white noise with a long decay through an HPF may do the trick. If you're prepared to add some effects and processing, however, you can make something usable quite easily from a snare patch; what you're after is a basic snare sound made almost entirely from filtered noise, with no real note to it.

The first step is to heavily EQ the sound by cranking up the mid boost control on your desk as far as it will go (don't use mole grips for this!) and then adjusting the frequency until you get a nice aggressive snap. As you tune through the EQ, you'll get to a point where the patch sounds like a techno snare or exploding champagne cork. If you keep pushing the frequency up, you'll move into the clapping region. If you go too far, you'll lose the snap and end up with a thin edge to the sound, but as every EQ behaves differently, it's best to do this by ear rather than try to follow any figures I might give you.

At this point, you have a single and none too convincing clap, but there are several ways of turning this sound into a thick ensemble, the first and easiest of which is to feed it through a gated reverb patch. Gated reverbs are actually short bursts of closely spaced reflections which neatly simulate a multitude of almost-in-time hands. You may also find that deliberately overdriving the reverb input makes the sound even more authentic.

If you don't have a gated reverb, try a short plate reverb with around 80ms of pre-delay, and if you don't have a reverb unit at all, use a digital delay to add one or more delays in the 50 to 100ms region. If you don't have a delay, but you're working with a sequencer and your analogue synth can be MIDI-controlled, simply copy the handclap track two or three times onto new tracks and delay the copies to create the ensemble effect. Again, delays between 50 and 100ms should work fine. If this seems a lot of trouble to go to, you could always just set it up once and sample it!

POST-PROGRAMMING

Once you've programmed your sounds to your satisfaction, there are a couple of points to be aware of.

• SAMPLING
If you don't have a MIDI-CV converter and a range of monosynths, you will have to sample sounds in order to use several at once (in a full, analogue-generated 'kit', for example). 8-bit sampling may change sounds containing high frequencies or too much resonance, but it can sometimes change the sound in *useful* ways. I once created a reasonable snare sound on my MS20, but when sampled and played back through an Ensoniq Mirage, it sounded more realistic! But more often than not, it is unrealistic (but usable) drum sounds you are after. If you sample in 16-bit, there is no real worry of losing any analogue 'feel', unless the sound uses slow LFO sweeps or Sample and Hold.

• LAYERING
Drum machines such as the TR808 and TR606 create their drum sounds by combining two or more sounds together. So if you are sampling your analogue drum sounds, try mixing several sounds together, for example a long TR808 kick (to rattle the floorboards) and a short pulse hit sound (for the percussive effect).

With some careful programming and mixing of sounds, powerful kicks and snares can be created without the need for any samples of real drums.

• GOING LIVE
If your analogue synth has filter cutoff CV inputs, and you have a MIDI-CV converter, you can obtain several versions of the same sound by opening or closing the filter on different beats via MIDI. If you have lots of analogue synths, running them live is certainly the most fun. It's a great feeling hearing all your percussion coming live from your analogues, knowing you can tweak any sound on the fly as you perform your final mix!

THE LAST WORD

Use the information here wisely and you'll be able to put a new sheen on your rhythm tracks. The quest for certain sounds will often throw up others, which you didn't realise were sonically generated in a similar way, and by means of these you'll widen your programming repetoire. Lastly, don't be afraid to experiment! Follow the general guidelines I have given, but be prepared to ditch it all if the snare patch you're creating turns into an amazing talking drum...

EXAMPLES 1.11-1.14: SH101 KICKS, THIPS, AND HITS

The SH101 is good for a wide range of kick sounds, with its powerful 24/dB filter. In all the following examples, set:

VCO MIX LEVELS	**0**
VCF MOD	**0**
KYBD	**0**
ATTACK & SUSTAIN	**0**

Also ensure the envelope release time is the same as the decay settings given, so the same length drum sound is played, no matter how long you hold the key down -- unless you want differing lengths of drum sounds on different beats.

1.11: STANDARD KICK

FREQ	**3**
RES	**10**
ENV	**3**
DECAY	**3.5**

If the decay time is increased, the kick will start to sound more like a tom drum.

1.12: TR808-TYPE KICK

FREQ	**3**
RES	**10**
ENV	**less than 2.5**
DECAY	**greater than 4**

Decay times of less than 4 are good for percussive clicks (see below).

1.13: CLICK

Whilst not strictly kicks, these sounds (essentially 'thips' with the top end taken off) are ideal for mixing *with* one of the above kick sounds, to give the 'click' sound of the stick hitting the drum skin.

FREQ	**0**
RES	**10**
ENV	**4-8**
DECAY	**less than 3**

Higher ENV values give more of a thip. To create a TR909-type kick, increase the decay in the above example. For more variations and unusual effects on any of the above examples, add VCF MOD (try settings of 1-3) with the LFO speed set to 10.

1.14: PULSE HITS

FREQ	**1-4**
RES	**10**
ENV	**7-10**
DECAY	**1-2**

EXAMPLE 1.2: PRO ONE KICKS

The Pro One produces decent kick sounds in the same way as the SH101. Set all modulation matrix switches TO to OFF.

OSC A & B LEVELS	**0**
NOISE/EXT LEVEL	**0**
FILT & AMP ATTACKS	**0**

SUSTAINS	0
CUTOFF	0
RESONANCE	10
ENVELOPE AMOUNT	10
KEYBOARD AMOUNT	0
FILTER ENVELOPE DECAY & RELEASE	4-5.5
AMP ENVELOPE DECAY & RELEASE	6

Try a FILTER DECAY of 4, and a NOISE/EXT level of 4 for a dirtier sound.

EXAMPLES 1.31-1.32: MS20 KICKS AND HITS

1.31: KILLER KICK
The MS20 can produce some devastating kicks, with a killer bass end, even though it only has a 12dB/octave filter. On the following example, set:

VCO 1 & 2 LEVELS	0
LPF & HPF CUTOFF	0
HPF PEAK	0
LPF & HPF MG/T.EXT	0
HPF EG2/EXT	0
EG2 HOLD	0
LPF CUTOFF	0
LPF PEAK	8
LPF EG2/EXT	8
EG2 ATTACK	0
EG 2 DECAY	2
EG 2 RELEASE	2

1.32: PULSE HITS
As in 1.31, but increase LPF PEAK to 10, LPF EG2/EXT to 10, and use a shorter DECAY setting. The MS20 pulse hits are less zappy than those on the SH101, but good nonetheless.

EXAMPLE 2.1: MS20 SNARE

On the following example, set:

VCO 2 LEVEL	0
LPF & HPF MG/T.EXT	0
LPF & HPF EG2/EXT	0
EG 2 HOLD	0
EG2 ATTACK & SUSTAIN	0
VCO 1 WAVEFORM	noise
VCO 1 LEVEL	10
HPF	4
HPF PEAK	8
LPF	8
LPF PEAK	6
EG 2 DECAY	0.8
EG 2 RELEASE	0.8

Adjust the HPF setting to change the pitch of the snare. The HPF PEAK setting changes the volume of the snare's pitch.

EXAMPLES 2.21-2.22: SH101 NOISE SNARES

In both the following examples, set:

VCO MIX LEVELS	**0**
VCF MOD	**0**
KYBD	**0**
ATTACK & SUSTAIN	**0**

In both examples, set the release time to the same as the decay settings given — so no matter how long you hold the key down, the same length drum sound is played.

2.21: STANDARD NOISE SNARE

NOISE	**10**
FREQ	**10**
RES	**0**
ENV	**10**
DECAY	**1-2**

Try different FREQ levels. Increase the decay time as you decrease FREQ (for example, try FREQ 2, DECAY 3). With lower FREQ settings, try adding VCF MOD for variation. Use maximum LFO speed, with a square modulating wave (this will sound more cutting). Set VCF MOD around the maximum level.

2.22 FILTERED NOISE SNARE

FREQ	**2**
RES	**0**
ENV	**10**
VCF MOD	**0-10**
DECAY	**2-3**

EXAMPLES 3.11-3.12: MS20 HI-HATS & CYMBALS

3.11: MS20 HI-HAT
In the following example, set:

LPF & HPF MG/T.EXT	**0**
LPF & HPF EG2/EXT 0	**0**
EG 2 HOLD 0	**0**
EG2 ATTACK/SUSTAIN 0	**0**
VCO 1 WAVEFORM	**any (not noise)**
VCO 1 SCALE	**4'**
VCO 1 PW	**0 to centre**
VCO 2 WAVEFORM	**RING**
VCO 2 SCALE	**2'**
VCO 1 & 2 LEVELS	**10**
HPF CUTOFF & PEAK	**0**
LPF CUTOFF	**10**
LPF PEAK	**0**
EG 2 DECAY	**2**
EG 2 RELEASE	**0.6**

Different VCO 1 waveform settings give slightly different tones. Noise on VCO 1 cannot be used, as a normal waveform must be selected for good ring mod sounds. Although the VCO 1 pulse width settings shouldn't affect the sound, they do!

Adjust the VCO 2 pitch to get a good discordant sound (try -5 or +5), and reduce VCO 2's level to attenuate the discordant effect. Play the highest note on the

MS20 keyboard. Try LPF CUTOFF settings of 7-8 and LPF PEAK settings of about 8 for more variations. By adding resonance on the LPF, you create more ringing, discordant sounds for a more metallic effect.

For those more familiar with their MS20, set LPF CUTOFF to 10 and LPF PEAK to 10. Patch the white noise generator to the VCA IN, the VCA OUT to EXT SIGNAL IN, and MOD WHEEL to VCA CONTROL INPUT. This will add noise to the sound; just adjust the mod wheel to obtain a desirable level of noise mix.

3.12: MS20 CYMBAL
In the following example, set:

LPF & HPF MG/T.EXT	**0**
LPF & HPF EG2/EXT	**0**
HPF CUTOFF	**8**
HPF PEAK	**6**
EG 2 HOLD	**0**
EG2 ATTACK	**0**
VCO 1 WAVEFORM	**RAMP**
VCO 1 SCALE	**4'**
VCO 2 WAVEFORM	**RING**
VCO 2 PITCH	**+2**
VCO 2 SCALE	**4'**
VCO 1 LEVEL	**10**
VCO 2 LEVEL	**10**
LPF CUTOFF	**10**
LPF PEAK	**10**
EG 2 DECAY	**0**
EG 2 SUSTAIN	**3**
EG 2 RELEASE	**4**

Patching the white noise generator into the mod wheel as described in 3.11 above allows you to adjust the noise mix from the wheel. Use the highest note on the keyboard, and play fairly short notes. The short decay time gives a percussive hit sound. Once the sound has settled to the sustain level, the release gives a ride-type cymbal decay. By setting DECAY to 2 and RELEASE to 0, you get even more hi-hat sounds.

EXAMPLES 3.21-3.22: SH101 HI-HATS

In both the following examples, set:

VCO MIX LEVELS	**0 (except NOISE)**
VCF MOD	**0**
KYBD	**0**
ATTACK & SUSTAIN	**0**

Do not use any VCF ENV depth, unless you want peculiar sounds. Also, set the decay time shorter than the release time. This way, you can have open hi-hats with a long key press, and closed hi-hats with a short press.

3.21: STANDARD WHITE NOISE HI-HAT

NOISE	**10**
FREQ	**greater than 7**
RES	**5-8**
DECAY	**4**
RELEASE	**1**

Add VCF MOD for more effects. Use maximum LFO speed, a square wave, and a VCF MOD depth of around 5-8.

3.22: METAL HI-HAT
Although the SH101 does not have a ring modulator, it can still produce some good metal hi-hats by using resonance with fast VCF MOD, or by tuning one of the oscillators close to the pitch of the resonance, producing a beating, discordant, metallic sound.

Using the white noise hi-hat in 3.21 as a starting point, add various levels of RES for more metallic hi-hats. Try reducing the NOISE level compared to the resonance to obtain a good balance, but at the same time reduce VCF MOD to less than 2. Adding VCF MOD (with a depth of less then 1), can give more of a discordant sound, very similar to the effect of ring modulation.

Set the keyboard transpose and RANGE to the highest settings, and increase the

VCO level to maximum (with either square or sawtooth wave).

Play a key near the top of the keyboard, and adjust the tune knob until the VCO is close to the pitch of the self-oscillating filter. Get them to beat with each other; this will give an even more metallic sound. The more VCOs you have beating together, the better! Make sure ENV and KYBD are set to minimum.

EXAMPLE 4.1: MS20 CLAPS

VCO 1 WAVEFORM	**noise**
VCO 1 LEVEL	**10**
VCO 2 LEVEL 0	**0**
LPF & HPF MG/T.EXT	**0**
HPF EG2/EXT	**0**
HPF CUTOFF	**6**
HPF PEAK	**7**
LPF CUTOFF	**10**
LPF PEAK	**0**
LPF EG2/EXT	**10**
EG 2 HOLD	**0**
EG2 ATTACK & SUSTAIN	**0**
EG 2 DECAY & RELEASE	**1.2**
MG FREQUENCY	**10**
MG WAVEFORM	**centre (square)**

Patch the MG square wave out into VCA CONTROL, SIGNAL OUT to VCA IN, and VCA OUTPUT to your mixer. Try different HPF CUTOFF and HPF PEAK settings for different clap sounds.

MISCELLANEOUS PERCUSSION

• WHOOSHES
Any synth with a white noise generator can produce whooshes, simply by sweeping the filter as noise passes through it. This example shows how it's done on the SH101, and this effect is easily reproduced on other monosynths. Set:

VCO mix levels	**0 (except NOISE)**
VCF MOD	**0**
KYBD	**0**
ATTACK & SUSTAIN	**0**
NOISE	**10**
FREQ	**1-4**
RES	**3-6**
ENV	**7-10**
DECAY	**4-6**
RELEASE	**1**

Also set up VCF MOD; set the MOD depth between 2 and 8. Try any LFO speed; slow speeds around 5 sound good. The most usable LFO waveform is square.

This is sound that likes to be flanged. If your effects processor has 'triggered flange', use it.

• PITCHED ENVELOPE SOUND
This sound uses an envelope signal to modulate the pitch in a large downward sweep, and is ideal for kick and snare sounds. Also, it is a sound you do not hear much at present -- so you can be the first to bring it into the top 10! Unfortunately, a possible reason for this is that not many synths have the ability to produce this sound: a few that can are the Pro One, Octave Cat, and Korg MS10 or MS20. Here's an example on the Pro One:

Set all TO switches on the modulation matrix to OFF, except OSC A FREQ -- set this to DIR.

Set modulation matrix FILT ENV FROM amount to maximum, and switch to DIR. Turn OSC A's frequency and OCTAVE switch to its lowest settings. Either waveform can be used. Then, set:

OSC A LEVEL	**10**

OSC B LEVEL	**0**
NOISE/EXT	**0**
CUTOFF	**0-10**
RESONANCE	**0**
ENVELOPE AMOUNT	**0**
KEYBOARD AMOUNT	**0**
ATTACKS/SUSTAINS	**0**
DECAYS/RELEASES	**5-6**

Try different AMP DECAY settings for longer/shorter sounds. The filter's decay must not finish before the amplifier's, otherwise the sound will be too much like a musical note. Add resonance to give this sound a hint of 'thip'!

• COWBELLS
These are created by mixing two square waveforms at different frequencies, and passing both through a band-pass filter (if you have access to one). Set the oscillator frequencies and BPF cutoff to settings that sound best for you, and use a short decay time on your VCA EG.

• MARACAS OR CABASAS
These are easy! Pass white noise through an HPF, then use a short decay time on the VCA EG.

• TOMS AND CONGAS
Toms are basically an oscillator swept down by an envelope signal. Some analogue drum machines add a touch of white noise passed through an LPF, with a longer decay time than the oscillator to add artificial reverberation. Congas are created in the same way, but without the noise and different pitch and decay settings.

Published in SOS April 1996

top ▲

Home | Search | News | Current Issue | Articles | Forum | Subscribe | Shop | Readers Ads
Advertise | Information | Links | Privacy Policy | Support

Sound On Sound Ltd is registered in England and Wales. Company number: 3015516. VAT number: GB 638 5307 26.
Registered office: Media House, Trafalgar Way, Bar Hill, Cambridge, CB23 8SQ, United Kingdom.
Email: Contact SOS | Telephone: +44 (0)1954 789888 | Fax: +44 (0)1954 789895