Review: SCATT MX-02 Electronic Trainer
New System Works for Live Fire and Dry Fire, Indoors and Outdoors

by Tony Chow

Introduction

In recent years, the use of electronic trainers has revolutionized training in all disciplines of position shooting. By capturing valuable metrics like the steadiness of a shooter's hold, accuracy of aiming, and the timeliness of trigger release, these devices can offer tremendous insight into the strengths and weakness of a shooter's position and technique, making marksmanship training less of an "oral tradition" and more of a science. Popular trainers on the market include RIKA, Noptel, and the most ubiquitous of all, the SCATT Training System.

All existing electronic trainers on the market operate on the same basic principle: a sensor attached to the rifle monitors the position of an infrared light source close to the target; the position of the light source within the sensor's field of view determines the rifle's point of aim at any given instant. These products' common reliance on infrared results in a common weakness: the inability to use them in outdoor ranges for live fire training, as sunlight is full of infrared radiation that overwhelms the sensor.

Now, a new product has entered the market. SCATT's next-generation MX-02 electronic trainer promises to perform just as well as the company's older WS-01 infrared-based trainer in dry fire, but with the new ability to be used in live fire under broad daylight, with both smallbore and centerfire calibers. As a committed smallbore prone shooter who has long desired such a product, when I was offered a unit to review, I jumped on the opportunity. Does SCATT MX-02 live up to its lofty promises? That's the question this review seeks to answer.

What's in the Package

SCATT's previous-generation product, the WS-01, comes packaged in a large flat box. By contrast, the new SCATT MX-02 is packaged in a sleek 9"x7" nylon pouch, designed for portability. Inside it, we find a comfortably long 9-foot USB cable for the sensor, two hex wrenches, a basic instruction manual, and a padded plastic box that contains the sensor, the mounting bracket, as well as a USB thumb drive with the SCATT software on it.

The contents of the SCATT MX-02 package

The MX-02 package is reduced in size due to the absence of a powered target frame. Unlike the electronic trainers that came before, the MX-02's sensor operates in the visible spectrum, which eliminates the need for an infrared light source at the target end. Essentially, the sensor is a high resolution, high-speed camera, capable of recognizing the target's dark bullseye within its white background, and assessing the rifle's point of aim based on the bullseye's position within its field of view.

SCATT MX-02 Sensor (left) alongside the SCATT WS-01 Sensor (right)

Despite its sophistication, the MX-02 sensor is impressively compact. It is only slightly bulkier than the WS1 unit, and not much heavier; with the sensor attached, the shooter is unlikely to notice any change in the rifle's balance. There is a lever on the sensor itself, which the user needs to adjust to focus the sensor on the target, depending on the distance between the two. The adjustment range is from 2.5 meters to infinity. A setscrew locks the focal distance in place.

The SCATT MX-02 sensor, seen mounted on a Grünig & Elmiger Racer smallbore rifle

The sensor is attached to a V-shaped mounting bracket through a dovetail interface, which in turn clamps onto the barrel of the rifle with a metal band. The band locks onto the mounting bracket through one of its six perforations on one end, and a screw on the other end, which tightens the whole bracket-band assembly around the barrel.

For more information or to order SCATT products, including the new MX-02, visit ScattUSA.com or call toll-free: 1-855-57-SCATT (72288).

Setting up the SCATT MX-02
For existing users of SCATT, setting up the MX-02 is a familiar and intuitive process. The sensor is fastened to the end of the barrel, and connected to a laptop computer, on which the SCATT application is installed. For dry firing, the SCATT application prints out targets scaled to the appropriate distance. The target is taped to the wall or some other vertical surface. **The target face needs to be very well lit**, particularly for MX-02, since both the shooter and the sensor need to be able to "see" it. A table lamp works nicely.

When live firing, the shooter simply fires on normal, full-sized targets. One major caveat is that you may not use multiple-bull American smallbore targets. For the time being, at least, the SCATT software supports only single-bull targets.

Now is the time to sling up and get in position. The shooter starts the SCATT application on the laptop and selects the discipline he or she desires to train in. There are numerous choices, from NRA High Power to International 50 meters. Upon selecting a program, the shooter is presented with a screen to fire one shot to calibrate the sensor. If the sensor "sees" the target, the calibration screen shows a crosshair indicating where the

target is in the sensor's field of view. Upon detecting the calibration shot, the software is ready to record shot tracings and metrics, using the calibration shot's placement as its initial zero.

The sensor calibration screen for SCATT MX-02. The crosshair represents where the target bullseye is within the sensor's field of view.
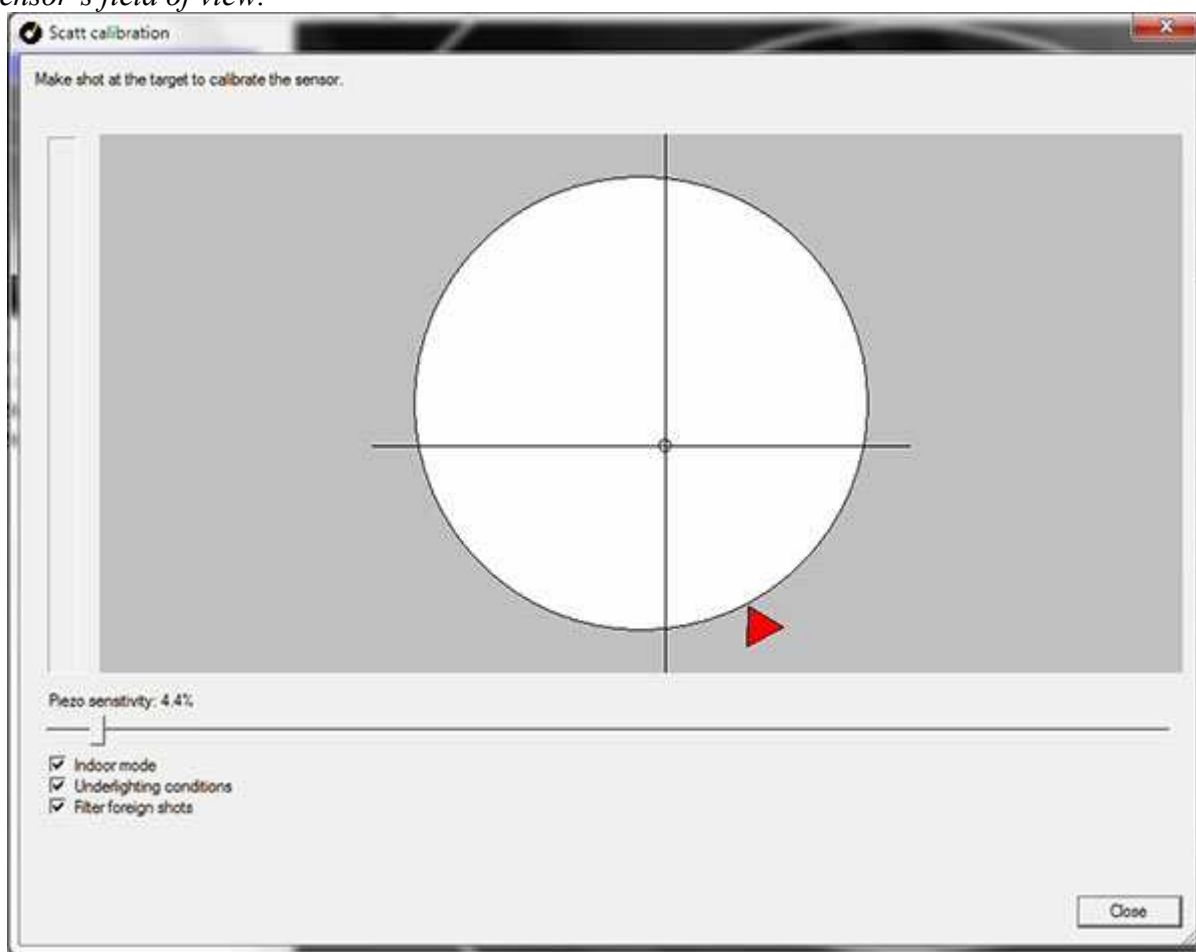
This is when setup could get a bit complicated. In my experience, the calibration process is trouble-free for live fire at 50 meters and beyond. However, if you are dry firing within confined spaces where the target-sensor distance is less than 10 meters, you will likely run into a snag during calibration: no crosshair would appear on screen and your shot would fail to register. This is due to the fact that the sensor has not yet been adjusted to compensate for parallax, which is caused by the several inches of distance between the line of sight for the shooter, which is above the barrel, and the line of sight for the sensor, which is beneath the barrel. The SCATT MX-02 sensor is sensitive to parallax because it has a very small field of view compared to its IR-based predecessor. At live fire distances, parallax becomes insignificant and does not pose a problem. But at short shooting distances, when the shooter's line of sight centers on the target, the target might be completely out of the sensor's field of view.

To compensate, MX-02's mounting bracket is equipped with two brass setscrews with which you can fine-tune the "aim" of the sensor. To aim the sensor upward, flip the bracket so that the screws are at the rear, and turn both screws the same number of revolutions inward. Conversely, position the screws at the muzzle end to aim the sensor downward. Turn one screw more than the other to move the aim left and right.
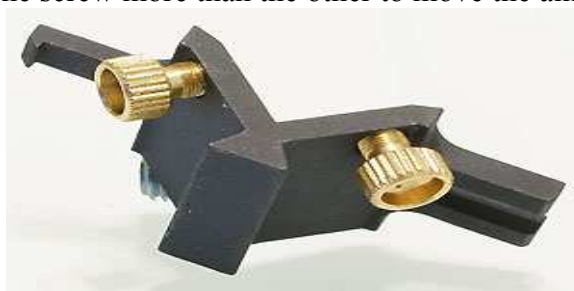
This is a procedure more easily performed while the rifle is on a rest rather than in position. To determine the direction in which you must move the sensor, and by how much, you will need to shift the aim in all four directions until the crosshair lands on the center of the calibration screen. And then, you need to adjust the setscrews incrementally until the lines of sight for both the shooter and the sensor converge on the center of the target. Fortunately, this is a one-time ordeal. Once you find the correct setting, I recommend putting a drop of green Loctite on both screws to ensure that they stay put over time. (Be careful that the Loctite doesn't seep into the sensor dovetail and prevent you from removing the sensor later, which you need to do in order to change the focus.)

Dry Firing Evaluation

Even though outdoor live fire capability is MX-02's main selling point, most buyers will want to use it mainly in the same way as they did the previous generation of SCATT: dry firing at home. Home training is convenient, saves ammo, and many problems in shooting technique can be diagnosed and corrected through dry firing. In order to be considered a viable product, therefore, the MX-02 must work as well in dry fire as did the previous generation trainers.

Here is the author's dry fire setup. The target paper is held in the disconnected target frame of a SCATT WS-01, but any well-lit vertical surface will do.

In this respect, the MX-02 doesn't disappoint. I alternately performed 10-shot strings using both MX-02 and the IR-based WS-01, and the results are practically the same. The tracings produced by both sensors are very comparable. The shot metrics obtained from MX-02, such as stability of aiming and tracing length, are also within my normal ranges.

A typical dry fire tracing from SCATT MX-02 (left) alongside a tracing from SCATT WS-01 (right).
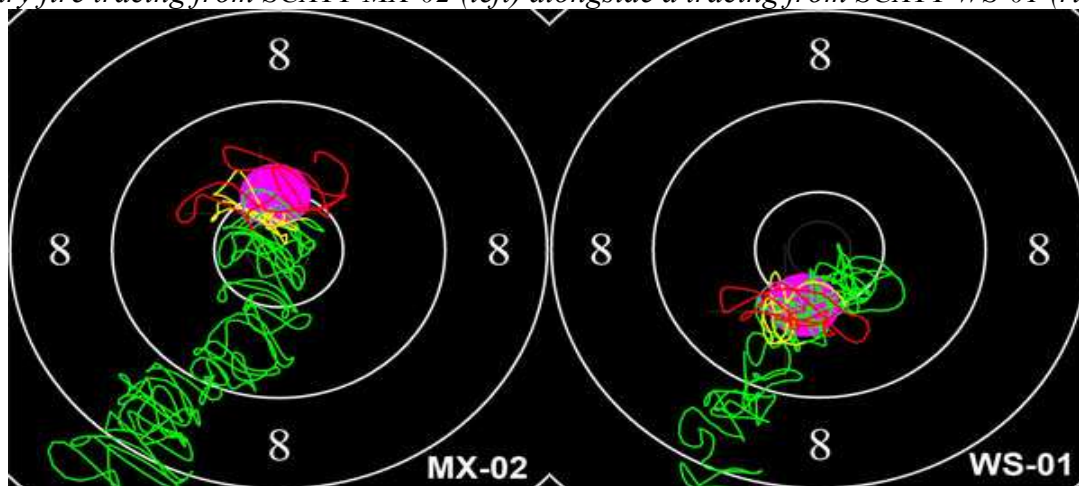
To put it simply, aside from a somewhat more complicated calibration process, dry firing with MX-02 is typical SCATT, and that's a good thing. SCATT MX-02 uses the same Windows software for data capture and analysis as its predecessors. This means that shooters and coaches upgrading to MX-02 will have no learning curve to overcome, and newcomers to the SCATT platform can tap into the wealth of knowledge accumulated over the years by the shooting community on how to interpret shot data.

Live Firing Evaluation: Smallbore

Strictly speaking, several electronic trainers on the market already support live firing; in the case of SCATT WS-01, a special target frame, containing IR emitters and designed to be placed near the actual target, can be purchased to enable this feature. However, due to the nature of infrared, such support has been restricted to indoor use only. Since access to full distance indoor ranges suitable for position shooting is extremely limited, especially in North America, most shooters have been effectively denied the possibility of using SCATT in live fire. The SCATT MX-02 is the first electronic trainer to overcome this limitation and fully support outdoor use, finally making live fire capability available to the vast majority of shooters.

SCATT MX-02 is designed to work with both smallbore and centerfire calibers. At the time of publication, we have only tested the review unit with smallbore rifles. An upcoming revision to this review will contain evaluation results from High Power shooting.

Testing Methodology

The smallbore live fire evaluation took place at my home range, Los Angeles Rifle & Revolver Club. The SCATT MX-02 was used alongside a SIUS ASCOR electronic target. The weather in Southern California was sunny and largely wind-free throughout the multiple evaluation sessions.

I wanted to find out if SCATT's usefulness might vary among shooters of different skill levels. Therefore, two prone shooters took part in the test: myself, a high-level shooter who averages mid-to-high 590s on the ISSF 50m target; and Jober Velasco, an intermediate-level club shooter averaging around mid-560s. This gave me the opportunity to act as the coach to Jober, and to use his SCATT data to come up with performance suggestions.

We each performed multiple 10-shot strings. After each string, we took a snapshot the group on the SIUS target, and saved the corresponding SCATT tracing file for later comparison.

We didn't spend a lot of time trying to match the zero on "paper" and the zero in SCATT. While centering the groups in both places is possible, I don't consider it worth the time, as we are mainly interested in comparing the shapes of the groups and reading the tracings.

Results: Intermediate-Level Shooter

A selection of strings shot by Jober Velasco is provided below, with each live-fire group on top of its SCATT counterpart.

Here are Jober's strings. The live fire groups are on top, the SCATT groups at the bottom.
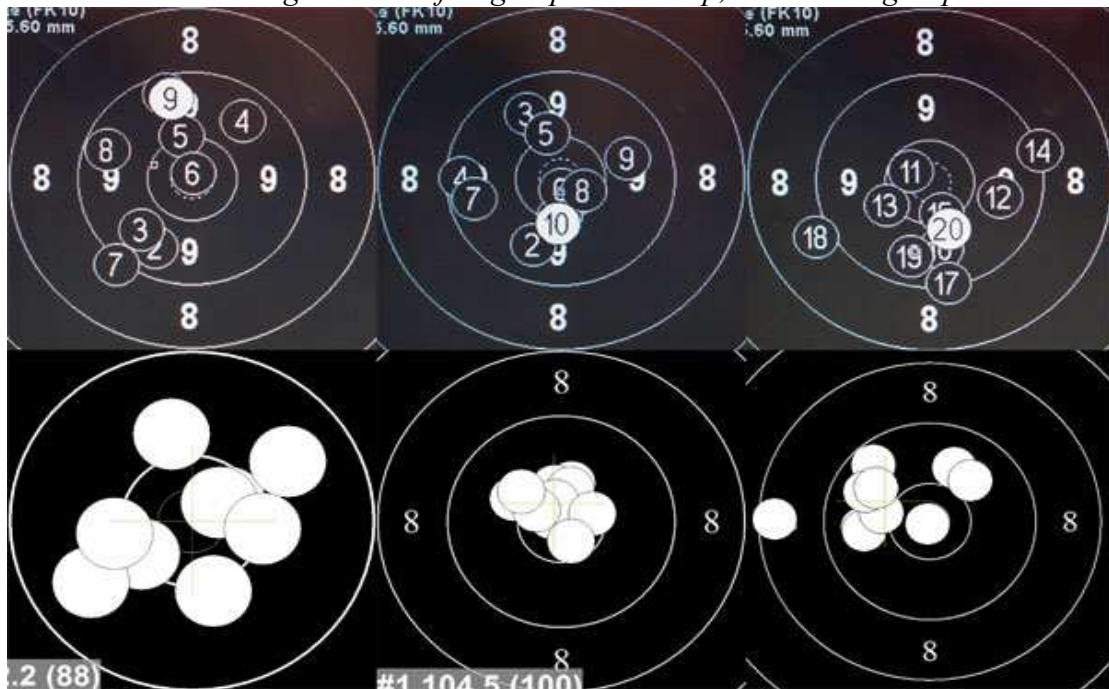
As we can see, the shapes of SCATT and live-fire groups are largely comparable. It is not realistic to expect them to match exactly, due to the random dispersion inherent in the ammunition, which SCATT cannot replicate. Ammunition is especially a factor in Jober's groups, as he was shooting his sub-optimal practice ammo, which is likely why his second live fire group is so much larger than the SCATT group.

Despite the uncooperative ammo, the tracings captured by SCATT explain a lot about Jober's performance. Take, for example, shots marked #14 and #18 within his third 10-shot string, which are to the extreme right and left of the group, respectively, both in SCATT and on the live target. The shot tracing in shot #14 shows that his aim was high, and then got pulled to the lower right at the moment of shot release, whereas during shot #18, his aim was continuously listing toward 8 o'clock. This tells us that Jober needs to improve his trigger release, during which the point of aim should not move. The quality of his natural point of aim is also suspect, as a shooter's aim tends to drift to his true NPA if it is not aligned with the center of the target.

The SCATT tracings tell us exactly what caused Jober's two worst shots to go so far afield. Disregard the fact that SCATT zero is quite a bit off from the live zero; the relative position of two shots is what we are interested in.

Jober's wobble zone, as indicated by the yellow line, is a little larger than the 10-Ring. It can certainly be reduced considerably, if he works on improving his position. His approach to the center, as indicated by the green line, is rather chaotic, which suggests to me that he is steering the gun to the center rather than relying on a sound NPA. Jober's recoil pattern, indicated by the red line, is usually vertical, but can sometimes be completely out of control, as shown in the following tracing:

Bad Recoil Revealed — Here is a particularly bad recoil pattern from Jober.
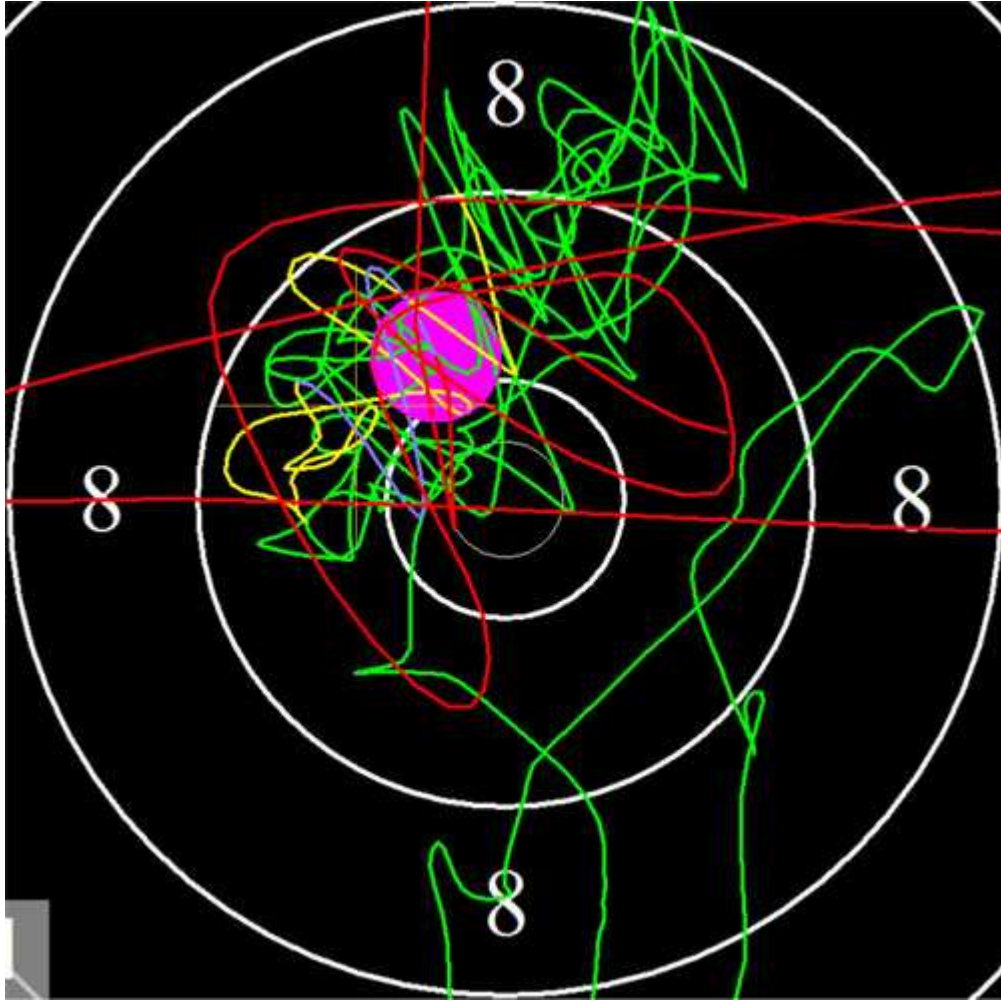
Thus, the use of SCATT MX-02 in live fire has given us considerable insight into the performance deficiencies of an intermediate-level shooter. Granted, a lot of this information can be acquired from dry firing with SCATT, but some factors, such as recoil characteristics and the role played by ammunition quality, can only be evaluated in live fire. We shall now see whether live fire data could be even more illuminating for a high-level shooter.

Results: High-Level Shooter

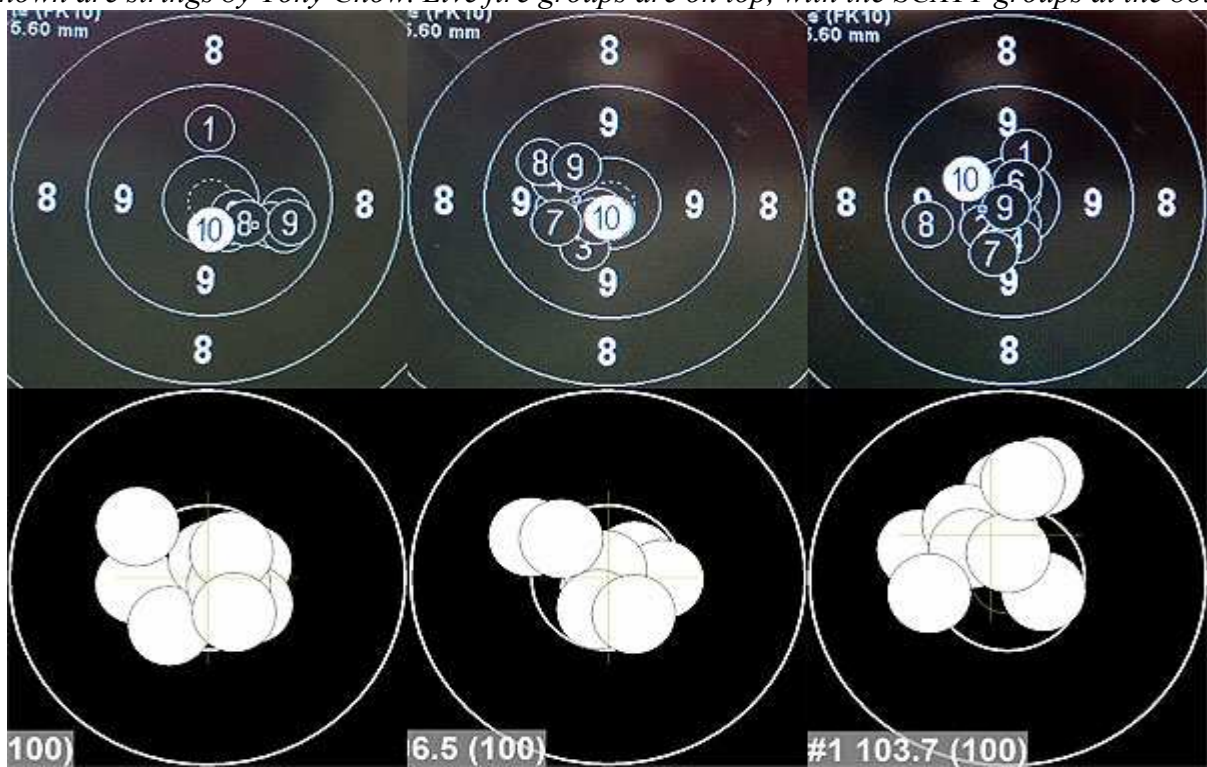A selection of strings shot by the author is provided below, along with some sample tracings.

The author, Tony Chow, in prone shooting position.

To reach world-class level in prone shooting, one needs to consistently land hits well within the 10-Ring. Frequent loose 10s and tight 9s are unacceptable. By these standards, my performance still has some way to go. So what clues can we glean from the SCATT data? The most obvious area of improvement is aiming accuracy. Points of impact on target correspond pretty well with the relative positions of points of aim shown in SCATT. In fact, SCATT offers a dedicated metric — Stability of Aiming — that shows at a glance the shooter's aiming consistency. Smaller numbers are better. On the 50m ISSF rifle target, aiming error of around 7mm is quite typical. A value of 5mm or under would be ideal.

Stability of time interval between shots (if all shots are equally spread the stability is 100%)	93%
Diametrical dispersion (group size) a center-to-center distance between two most distant shots	9.3 mm
Stability of aiming average points of the tracing are taken for a given interval of time before the shot, and the diametral dispersion of these points is calculated	6.9 mm

Aiming error is an important factor, but insufficient to explain my worst shots. Take shots #1 and #8 in the third string; they are at least 15mm apart from each other on the live target, center-to-center. Yet in SCATT, the aiming points of these shots (represented by the yellow crosshair marking the center of the last second of tracing) are just 5mm apart. What accounts for the rest of the dispersion? Ammunition could be an explanation, but considering the match-quality ammo that I was using—a lot of Lapua Center-X well suited to my rifle that regularly shoots decimal strings of 105.0 or better when I'm in top form—it's one that should be turned to only as a last resort in the analysis. In this case, the ammunition factor can be safely discounted, because the shot tracings contain a vital clue: for both shots, the direction of shot displacement is same as the direction in which the tracing is traveling at the junction between the blue and red parts of the line, which represents the first instant of shot release:

The author's two worst shots are well explained by the movement captured by SCATT MX-02.

This movement isn't the recoil, which is a much more violent motion constituting the bulk of the red portion of the tracing. Nor could is it likely to be the trigger jerk; if that were the case, it wouldn't be so brief in duration and random in orientation from shot to shot. Rather, the most likely explanation is that this area of the tracing is simply a moment in the natural vibration of the muzzle, the "wobble" within my wobble zone. If so, it would mean that the vibration inherent in my hold is a force strong enough to significantly displace the bullet in whatever direction the muzzle happens to be traveling at the moment of shot release.

An examination of the rest of the shots in the group seems to bears out this theory. Shot #7 is the lowest in the group, and the tracing shows that the muzzle is moving downward during shot release:

The low 7th shot correlates with a downward muzzle movement during release.

In some shots, the muzzle happens to be changing direction during shot release. In theory, the muzzle's momentum is at its slowest at such moments, and should not displace the shot as much. As it turns out, as these shots do happen to be some of the best in the group:

Some of the best shots occurred when the tracing happened to be turning during release.

For me, the fact that muzzle oscillation plays such a major role in determining shot placement is an important revelation. It tells me convincingly that to have fewer flyers and higher scores, I must work to reduce the amount of vibration in my hold. SCATT provides a specific metric, the Tracing Length, which can be used to assess the speed of muzzle vibration. At this time, even though I have a much smaller hold than Jober, my tracing lengths aren't much better than his—50mm to 60mm—indicating that the muzzle is vibrating very quickly within a tiny area. By contrast, world-class shooters exhibit tracing lengths in the 20-40mm range.

Trace Length Comparison
Tracing Length isn't a feature introduced by MX-02; previous generations of SCATT have always had this it. Yet until now, I have largely ignored this metric. Only with the help of MX-02, did I realize how important it truly is.

T. Chow trace lengths (left) compared to those of Russian shooter Marina Bobkova (right):

#	Result	Time	10.0	Length		#	Result	Time	10.0	Length	
1	10.4	16.6	90%	46.8	2.4	1	10.5	17.0	100%	32.9	0.5
2	10.2	16.2	95%	61.3	6.7	2	10.6	11.0	100%	32.3	2.9
3	10.9	29.9	97%	48.4	4.0	3	10.5	21.0	99%	31.0	1.0
4	10.3	15.2	100%	48.4	4.7	4	10.6	16.0	100%	34.9	1.2
5	10.7	25.0	97%	54.9	3.5	5	10.7	16.0	100%	39.5	1.4
6	10.3	15.7	99%	56.5	2.7	6	10.4	14.0	99%	32.4	2.6
7	10.7	22.8	86%	62.0	6.3	7	10.6	21.0	100%	38.1	0.5
8	10.3	19.8	100%	46.3	2.8	8	10.8	16.0	100%	27.1	0.8
9	10.7	18.9	98%	56.3	2.2	9	10.6	12.0	100%	26.3	2.2
10	10.5	26.1	83%	53.6	2.4	10	10.4	18.0	100%	29.5	0.7
100	105.0	20.6	94%	53.4	3.8	100	105.7	16.2	99%	32.4	1.4

This, to me, is where SCATT MX-02 proves its worth. Its outdoor live fire capability not only can provide information not available in dry firing, it can also help shooters and coaches better understand the significance of data captured in dry firing. There's simply nothing like being able to correlate SCATT tracings with the real holes on target, and that makes SCATT MX-02 a uniquely useful tool.

Conclusion

It isn't often that a product that promises so much ends up delivering on all counts. SCATT MX-02 comes very close. It is well made, portable, reliable, and, aside from a potentially more involved calibration process, easy to set up. In dry fire mode, it is a worthy successor to its IR-based predecessors, and provides the same wealth of data that users have come to expect from a SCATT product. MX-02's outdoor live fire capability works well and opens up intriguing training possibilities. When the data is interpreted correctly, it can reveal problems in shooting invisible in dry firing, as well as help users better understand the implications of dry firing data. I highly recommend this product for anyone serious about mastering position shooting.

The MSRP for SCATT MX-02 is $1,799, $500 more than its predecessor, the SCATT WS-01, which is still available for sale. In my view, the extra premium is justified by the new capabilities of the product. For newcomers to electronic trainers, SCATT MX-02 is undoubtedly a better value and long-term investment than its infrared-based competitors.

For those who already own an electronic trainer, whether it is worth upgrading to the MX-02 depends on the shooter's skill level. Beginners and intermediates still working on fundamentals should spend most of their training time doing dry firing. Accordingly, they may be adequately served by the IR trainers that they already own. On the other hand, more advanced shooters, who are chasing those last 5 points in their scores, should seriously consider upgrading to the MX-02, as they are in the position to fully exploit SCATT MX-02's powerful features.

Interested readers can examine SCATT MX-02 at the 2014 SHOT Show in Las Vegas. SCATT will have the MX-02 on display at SHOT Show Booth 111.

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http://www.accurateshooter.com/featured/review-scatt-mx-02-electronic-trainer/