The Definitive Guide to Electronic Warfare

by Ryysa

First of all, let's see what I classify as EW. Your classification might be different.
This guide is split depending on EW types:

1. Warp Scrambling
2. Stasis webifying
3. Target Jamming (ECM)
4. Sensor Dampening
5. Tracking Disrupting
6. Target Painting
7. Cap Draining (NOS/Neuts)
8. Chance calculation for falloff.
9. Multiplier calculation with stacking penalties.
10. Conclusion

1. Warp Scrambling

Short Description:
Warp scrambling prevents another ship from entering warp. This is the primary EW type used in any kind of pvp, because it allows you to prevent your target from escaping from an unfavorable situation.

Methods of application:
Modules - The modules are called warp scramblers and warp disruptors, and are fitted into midslots. They come in different varieties, with the important parameters being scrambling range and scrambling strength.

Mobile Warp Disruptors -
These are often referred to as "bubbles". They are static objects which can be deployed and anchored anywhere in space. They are characterized by their scrambling radius and come in multiple flavors. Small, Medium and Large. Mobile Warp Disruptors can only be used in 0.0 space. Bubbles can also pull ships out of warp in different positions than intended, but more on that later.

Interdictor spheres -
Interdictor spheres work the same way as Mobile Warp Disruptors, however they can be deployed on the fly and have a fixed scrambling radius of 20km. As with anchorable bubbles, usage of interdictor spheres is restricted to 0.0 space.

Working Mechanism:
Regarding modules, the best way to describe the workings would be to view every module as having a certain amount of "scramble points" (scramble strength). Let's say each ship starts out with 0 warp points and each scramble point deducts from that number. If the amount of warp points a ship has is negative, it can't enter warp. So if you apply a warp disruptor with strength 1 to a ship with a base amount of 0 warp points, it ends up with -1 warp points, thus it can't warp.

Bubbles (both anchorable and interdictor) work slightly different. First of all, the number of points is irrelevant here. Each bubble has a scrambling radius. If the ship's distance to the disruptor is less than the disruptors scrambling radius, then the ship is considered warp scrambled and cannot warp.

Another specific point about bubbles is that they are able to modify the place where ships exit warp. Ships can warp from object A to object B. Draw an imaginary line AB through object A and object B. If line AB intersects a bubble, which is in the same grid as object B, at the time when the ship starts the warp procedure at object A, then regardless at what range the ship warped to object B, it will end up out of warp where line AB intersects the bubble, on the edge of the bubble which is closest to object A.

Deductions - If the bubble is not in the same grid as object B, then nothing will happen, and if the bubble is not deployed before the target initiates warp at object A, it will not be affected by the bubble. Also note, that object A and B are not the same as celestial objects. Object A is the warp entry point and Object B is whatever object was warped to. This means celestial object, bookmark or gangmate. Running out of cap modifies the exit

point.

Skills affecting:
Propulsion Jamming - 5% Reduction to capacitor need of scrambling modules per skill level.
Anchoring - Reduces time to deploy anchorable bubbles.
Interdictors - Increases the ROF of the interdictor sphere launcher by 10% per skill level.

Specialized ships:
Ships with bonuses to scrambling are gallente.
Arazu/Lachesis - Recons, get 20% bonus to warp disruptor/scrambler range per recon level.
Alternatively, Interdictors are a ship class dedicated to deploying Interdiction Spheres.

Counters:
Counters to the module versions are Warp Core Stabilizers or WCS. Each WCS adds one warp point to the ship. Meaning that if a ship has one WCS fitted and no natural bonus to Warp Core strength, you will need 2 scrambling points to give it a negative amount of warp points and thus scramble it.

In case of ending up in a bubble, there are no direct counters, but due to bubbles having limited range, a speedy ship configuration is an indirect counter.
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2. Stasis webifying

Short Description:
Stasis webifiers decrease the speed of a given ship.

Methods of application:
Modules - Stasis webifiers are fitted into midslots and their most important parameters are Range and speed reduction amount.
Drones - Webifying also comes in drone form. However, webifying drones have a fairly weak effect - one good module is better than five drones. They also only come in the large variety, which makes them sluggish and due to their low hitpoints very vulnerable to takedown.

Working Mechanism:
This is fairly simple. Each stasis webifier has a certain speed reduction amount.
The formula would be:
V = V0 * (100% - S)
Where V0 is the ship's speed, and S the stasis web speed reduction parameter.

There are stacking penalties involved on webifiers. Please refer to section 9 of the guide on how to calculate the speed reduction multiplier of multiple webifiers against one target.

Also, the slowdown of the ship is not instant. It is gradual and depends on the mass of the ship.

Skills affecting:
Propulsion Jamming - 5% Reduction to capacitor need per skill level.

Specialized ships:
Ships with bonuses to stasis webifiers are from the minmatar and the bloodraider races.
Huginn, Rapier - Minmatar recons. Both get a bonus of 60% per recon ship level to stasis webifier range.
Cruor - Blood Raider frigate, 10% bonus to Stasis Webifier range per level.
Ashimmu - Blood Raider cruiser, 10% bonus to Stasis Webifier range per level
Bhaalgorn - Blood Raider battleship, 10% bonus to Stasis Webifier range per level

Examples:
Two 90% Webifiers get applied to a ship moving at 2000 m/s.

Speed of the ship after being dualwebbed:
2000 * (1-0.9) * (1-0.9*0.87) = 43.3m/s
While this is fairly trivial, pay close attention to where exactly the stacking penalty gets applied.
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3. Target Jamming (ECM)

Short Description:
ECM, when successful causes the target to lose all of their locks and in most cases be unable to re-lock for 20 seconds.

Methods of application:
Modules - There are two types of modules. The more widely used modules are Target Jammers, which upon success cause a lost lock and an inability to lock anything for the duration of their cycle time (currently 20 seconds). Target jammers come in two flavors. Multispectral jammers, which have the same chance to jam any kind of races sensors and racial jammers, which have a higher chance to jam a specific races sensors at the expense of having a lower chance to jam all others.

Here is a small table on racial sensors and jammers:
Race - Sensors - Jammer
Caldari - Gravimetric - Spatial Destabilizer
Gallente - Magnetometric - Ion Field Projector
Minmatar - LADAR - Phase Inverter
Amarr - RADAR - White Noise Generator

The other modules are ECM Bursts, which in case of success cause everything in their area of effect to lose lock, but don't prevent the target from reaquiring the lock during the duration of the cycle. Also only one ECM burst may be active at the same time, meaning that fitting more than one is fairly pointless.

The most important characteristics for modules are Cycle time, Jamming strength, Optimal Range and Falloff Range.

Drones - ECM also comes in drone form. There are light, medium and heavy ECM drones. The difference is most notably their speed and their jamming strength. With the recent changes, drones are the most viable ECM method for non-specialized ships.

Working Mechanism:
Jamming is chance based. Every ship in eve has a characteristic known as sensor strength.
The chance to jam a target with one jammer is illustrated by the following formula:
C = J/S * 100%
Where J is the jamming strength of your jammer, S the sensor strength of the target ship and C the jamming chance in %.

In case of ECM bursts, a separate chance roll is performed for each ship in range.

The chance to jam a target with multiple jammers is a simple deduction of Bernoulli's formula:
C = (1-(1-J/S)^n)*100%
Where J is the jamming strength of your jammer, S the sensor strength of the target ship, n the number of jammers and C the jamming chance in %.
Computing the chance to jam with different jammers with different jamming strength

against multiple targets is more for the realm of combinatorics enthusiasts, and is of little value here, so we shall not explore this further.

Jammers also have an optimal and a falloff range, please refer to section 8 on how to calculate the falloff multiplier.
Note that multiplying the strength of the jammer by the falloff multiplier is incorrect, because the checking for falloff and the checking for jamming chance are two separate events - you must multiply the result from the chance calculation by the falloff multiplier to get an accurate answer.

Modules/Rigs affecting:
Modules:
Signal Distortion Amplifier - Lowslot module, 16% increase in jamming strength for T1 version, 20% for T2.
Rigs:
Particle Dispersion Augmentor - 10% increase in jamming strength for T1 version, 15% for T2.
Particle Dispersion Projector - 20% increase to optimal range for T1 version, 25% for T2.

Skills affecting:
Electronic Warfare - 5% Reduction to capacitor need per skill level.
Signal Dispersion - 5% bonus to strength of all ECM jammers per skill level.
Long Distance Jamming - 10% bonus to optimal range per skill level.
Frequency Modulation - 10% bonus to falloff per skill level.

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4. Sensor Dampening

Short Description:
Sensor dampening reduces a ship's locking speed and locking range.

Methods of application:
Modules - Sensor dampeners are midslot modules, the main characteristics of which are Targeting Range multiplier, Scan Resolution multiplier, Optimal, Falloff.

Drones - Sensor dampening drones come in three flavors, from small to heavy, however due to heavy stacking penalties their effects are fairly limited, and they are rarely used.

Working Mechanism:
Each sensor dampener reduces a targets locking speed and range.
To calculate the Optimal range reduction for one dampener used against a target, the following formula is used:
R = R0*M
Where R0 is the targeting range of the ship with targeting range bonuses applied, M the targeting range multiplier of the dampening module or drone and R the resulting targeting range.

Calculating the locking speed reduction is slightly different due to the fact that the relation between locking time and scan resolution is not quite linear.
The formula for locking time is:
T = (40000/(M*X))/(asinh(Y)^2)
Where X = scan resolution of your ship with positive bonuses applied, Y = sig radius of the target, M the scan resolution reduction multiplier of the dampening module or drone and T the locking time.

Sensor dampeners are subject to stacking penalties and have a falloff range, please refer to sections 8 and 9 to learn how to calculate the falloff chance and the dampening multiplier with more than one module.
Another important thing to note is that if your locking range becomes shorter than your distance to your currently locked target, then you will lose the lock.

Modules/Rigs affecting:
Rigs:
Inverted Signal Field Projector - 10% increase to effectiveness for T1 version, 25% for T2.
Particle Dispersion Projector - 20% increase to optimal range for T1 version, 25% for T2.

Skills affecting:
Sensor Linking - 5% Reduction to capacitor need per skill level.
Signal Suppression - 5% bonus to effectiveness of sensor dampeners per skill level.
Long Distance Jamming - 10% bonus to optimal range per skill level.
Frequency Modulation - 10% bonus to falloff per skill level.

Specialized ships:
Dampening is the domain of the Gallente.
Maulus - Frigate, 5% bonus to dampening effectiveness per level.
Celestis - Cruiser, 5% bonus to dampening effectiveness per level.
Arazu, Lachesis - Recons, 5% bonus to dampening effectiveness per cruiser level.

Counters:
The direct counter to dampening are sensor boosters and signal amplifiers, which increase your scan resolution and locking range.

Examples:
A huginn with lvl4 signal suppression, two t1 dampening rigs and t2 dampeners dampens a falcon with lvl5 signature analysis and lvl5 long range targeting.

Range and scan resolution reduction from 1 dampener: -48%
1 Rig: 10% bonus to reduction
Signal suppression lvl4: 20% bonus to reduction

Multiplier to range / scan resolution from 1 dampener with 2 rigs and skills applied:
(1-0.48)*(1-0.2)*(1-0.1)*(1-0.1*0.87) = 0.3418272
For 3 dampeners:
0.3418272*(1-(1-0.3418272)*0.87)*(1-(1-0.3418272)*0.57) = 0.0913

Falcon base locking range: 120km
Falcon base scan resolution: 200mm

Falcon locking range after lvl5 skill: 120km*1.25=150km
Falcon scan resolution after lvl5 skill: 200mm*1.25=250mm

Falcon locking range after dampeners: 150km*0.0913 = 13.7km
Falcon scan resolution after dampeners: 250mm*0.0913 = 22.83mm
Huginn signature radius without penalties: 127m
Falcon locking time on huginn after dampeners: (40000/(22.83))/(asinh(127)^2) = 57.14 seconds

5. Tracking Disrupting

Short Description:
Tracking disruptors severely impair the effectiveness of turrets by heavily reducing their optimal range and tracking speed.

Methods of application:
Modules - Tracking disruptors are midslot modules. Their most important parameters are optimal range multiplier, tracking speed multiplier, optimal range and falloff range.

Working Mechanism:
Each tracking disruptor reduces the tracking speed and optimal range of turrets.
The effect can be calculated with the following formula for both tracking speed and optimal range:
R = R0*M
Where R is the resuling optimal range or tracking speed, R0 the optimal range or tracking speed of the ship with positive modifiers applied and M being the optimal range or tracking speed multiplier of the tracking disruptor.

Tracking Disruptors are stacking penalized and also have a falloff range. Please refer to the stacking penalty and falloff sections for details on how to calculate the multiplier with more than one module and to see how the modules operate within falloff.

Modules/Rigs affecting:
Rigs:
Tracking Diagnostic Subroutines - 10% increase to effectiveness for T1 version, 15% for T2.
Particle Dispersion Projector - 20% increase to optimal range for T1 version, 25% for T2.

Skills affecting:
Weapon Disruption - 5% Reduction to capacitor need per skill level.
Turret Destabilization - 5% bonus to effectiveness of tracking disruptors per skill level.
Long Distance Jamming - 10% bonus to optimal range per skill level.
Frequency Modulation - 10% bonus to falloff per skill level.

Specialized ships:
The specialized ships for tracking disruptors come from the amarr race.
Crucifier - Frigate, 5% bonus to tracking disruptor effectiveness per level.
Arbitrator - Cruiser, 5% bonus to tracking disruptor effectiveness per level.
Curse/Pilgrim - Recons, 5% bonus to tracking disruptor effectiveness per cruiser level.

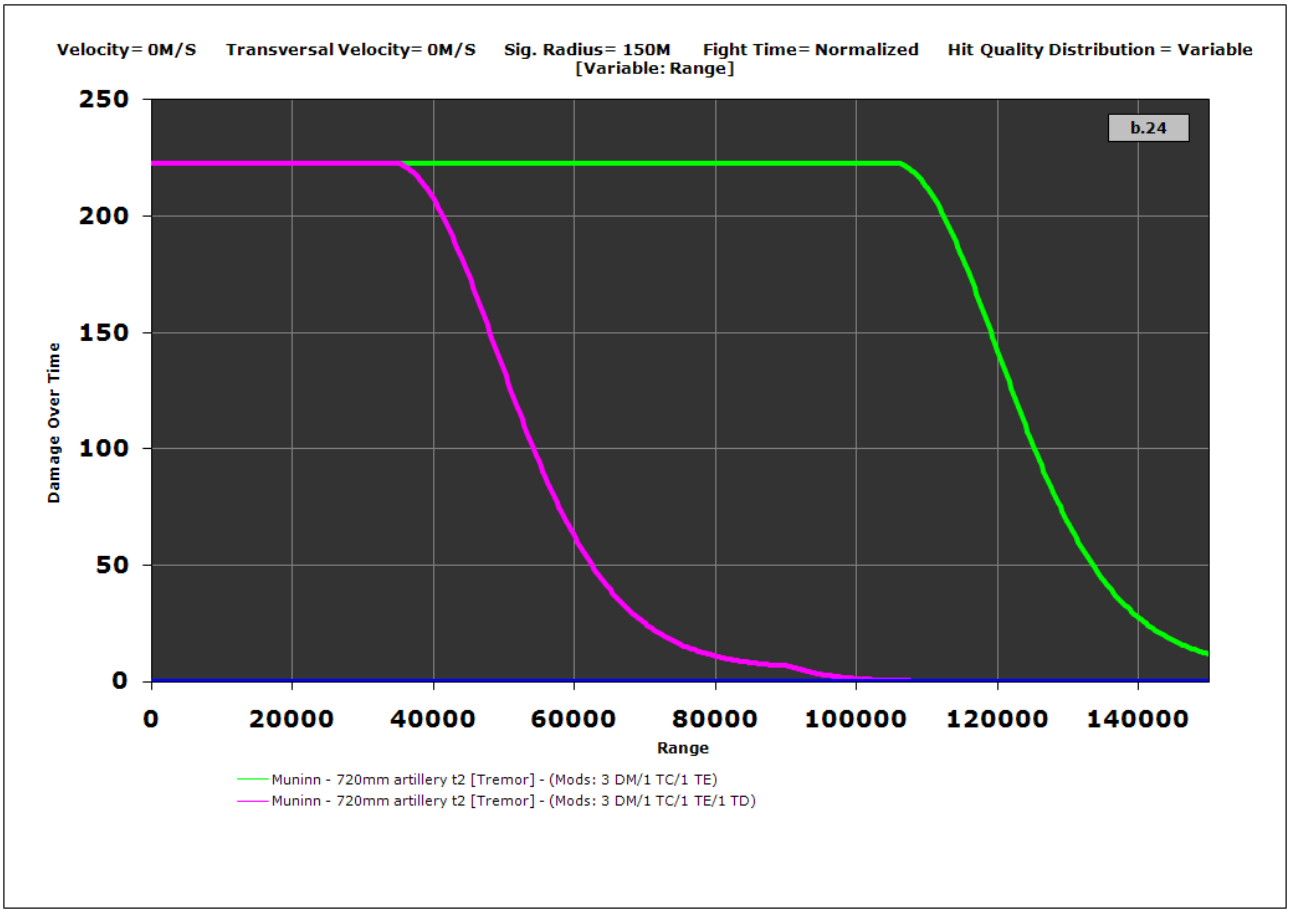
Counters:
The direct counter to tracking disruptors are tracking computers and tracking enhancers.

Examples:
This was a really hard one. Calculating numbers here is pointless, unless you are a complete ace with math, the numbers won't tell you anything at all. This is due to the complexity of the workings of turrets.

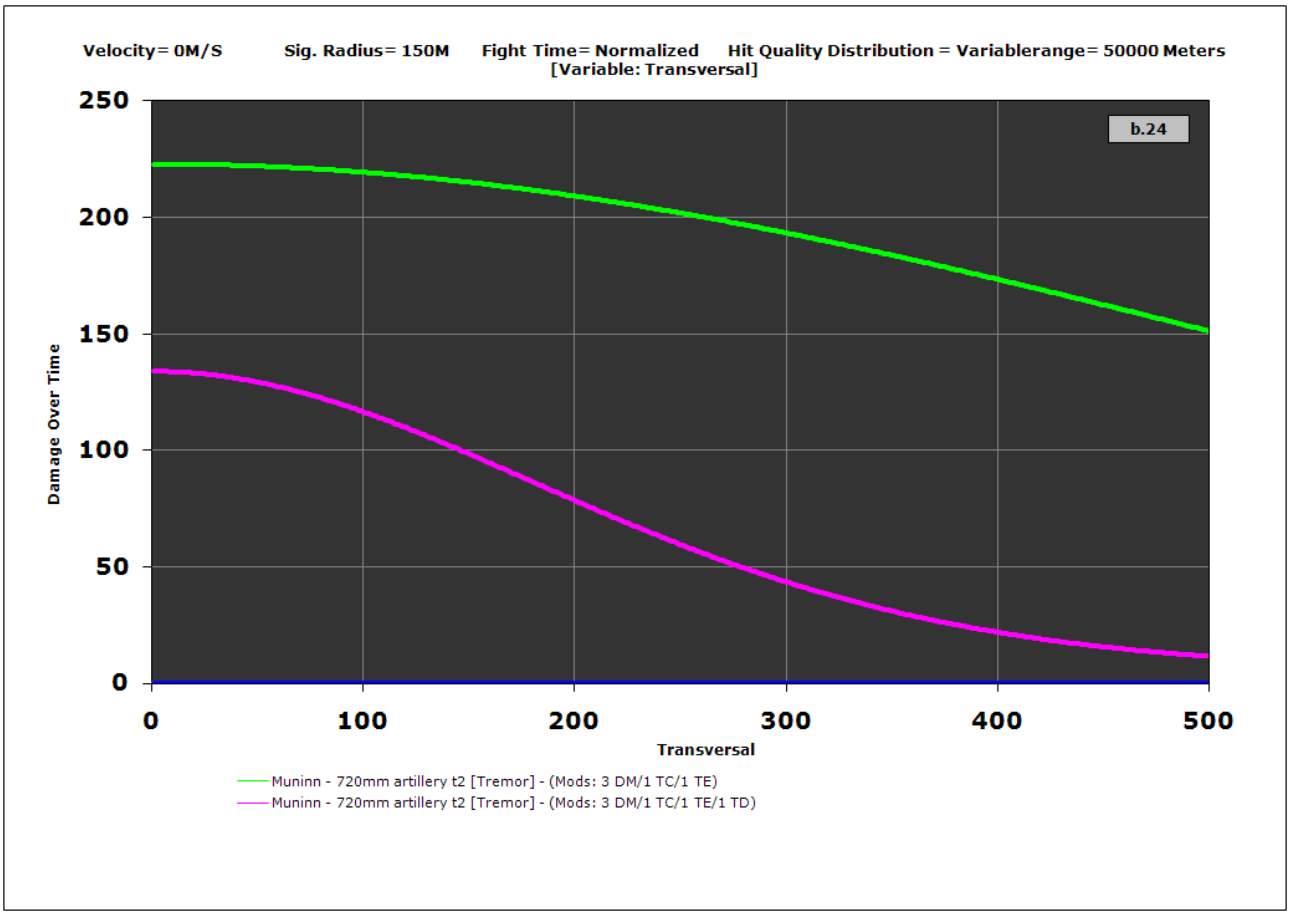
Instead, because I am a minmatar fanatic, I decided to analyze and graph the effect of one

tracking disruptor on the DPS (damage per second) of the two minmatar Heavy Assault Ships. In all graphs the green line indicates the original DPS and the purple line the DPS of the same ship with one T2 tracking disruptor applied to it.
In all graphs the target is a cruiser sized target with a signature radius of 150m and Naughty Boy's spreadsheet is used to draw the pretty graphs.

First up is the Muninn, a sniper, usually used at long ranges.

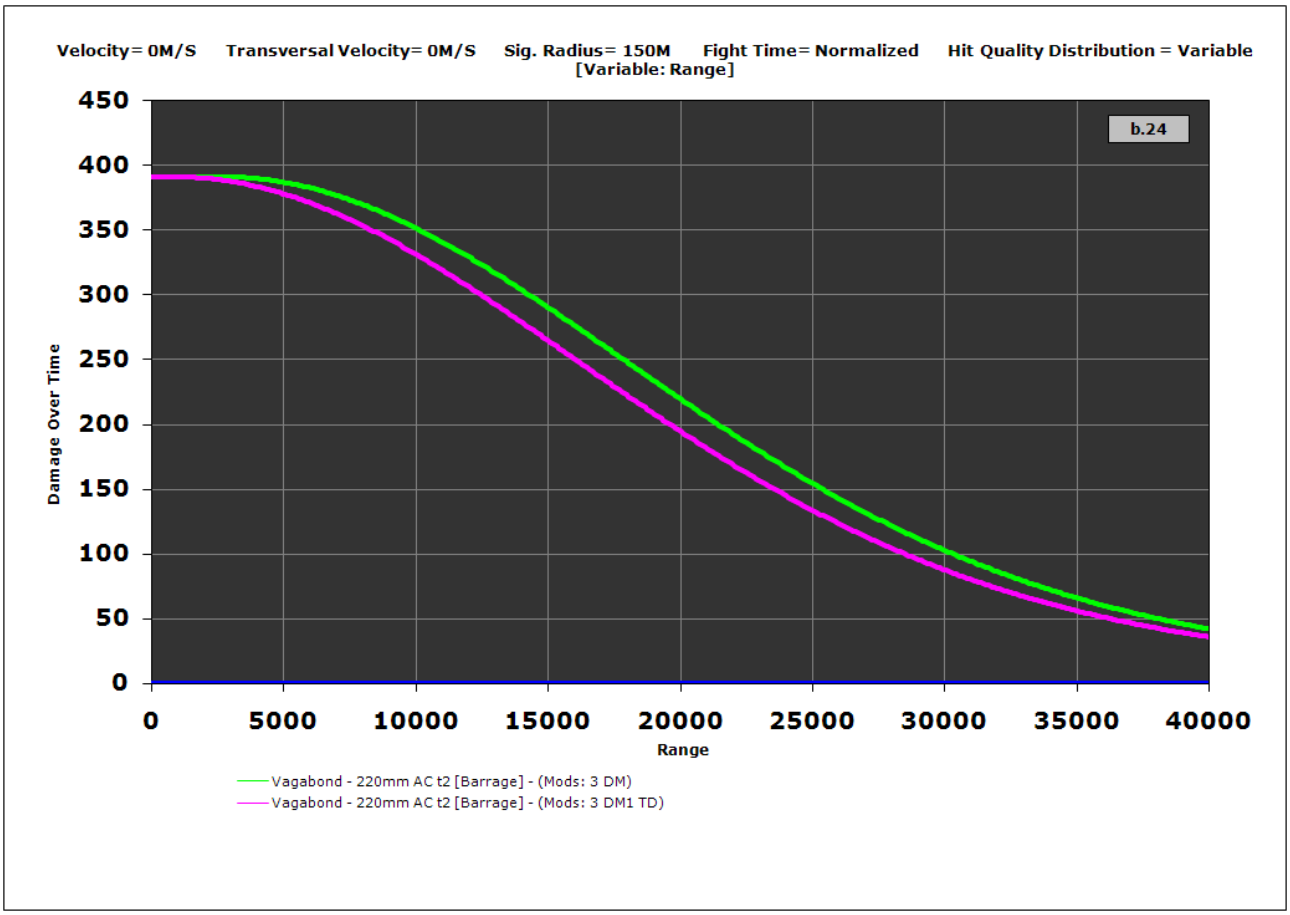


In the first graph we see the effect of a tracking disruptor on the ship's optimal range.
It is clearly visible, that with just one tracking disruptor the effective range of the muninn is reduced from about 115km to under 40km. Needless to say that it won't hit anything in it's intended range and will be effectively removed from combat with just one module.

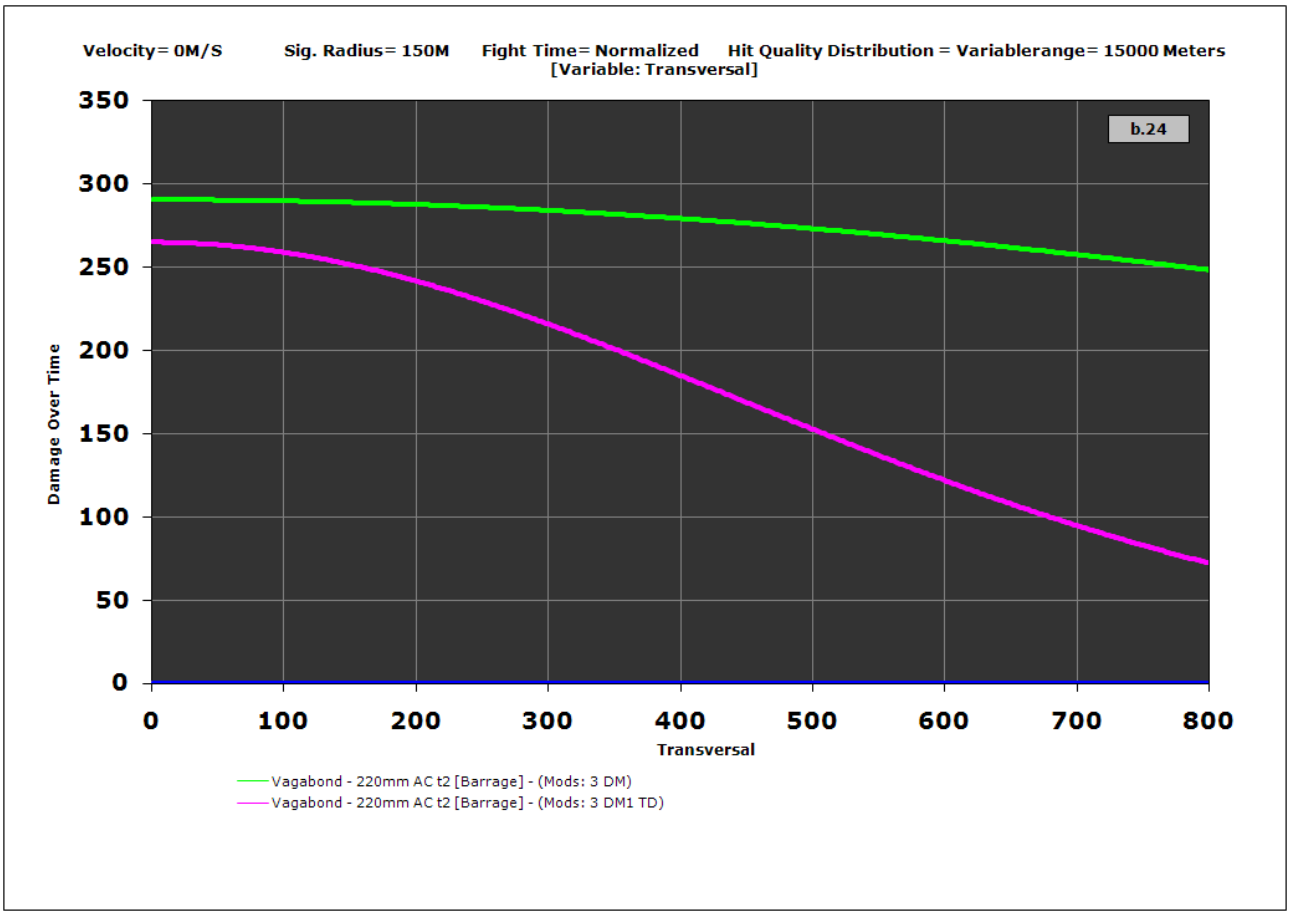


In the second graph the relationship between damage and speed is shown, with the target being at a fixed range of 50km. It is visible here, that besides already heavily reducing the muninn's optimal range, the transversal velocity to the target starts to have a bigger impact on the chance of hitting, however the difference is not nearly as pronounced as in the range graph.

Let's take a look at the second HAC, the Vagabond. This is a speedy ship used for closer range skirmishes at high speeds.



Again, I'll start off with a graph, which shows the effect on the damage regarding to the range from the target. You surely noticed that the difference is almost non-existant. This is due to the fact that autocannons operate in their falloff, meaning their optimal range is very small and unimportant, thus reducing it yields no noticeable results.



Looking at the second graph, which depicts the effect of transversal velocity we see a completely different picture. Due to very heavy reduction of the tracking speed, the vagabond loses a lot of damage very fast as transversal velocity goes up. The vagabond is a fast and agile ship, most of its fights take place with transversal velocities of over 800m/s, meaning that with just one tracking disruptor the vagabond will be made relatively useless, unless it gives up all it's speed, making it vulnerable to attack.

Hopefully this makes you understand the effect of tracking disruptors and where and how they can be useful.

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6. Target Painting

Short Description:
Target Painting increases the signature size of the target.

Methods of application:
Modules - Target Painters are midslot modules, the main characteristics of which are signature increase amount, optimal range and falloff.

Working Mechanism:
The working mechanism of target painters is fairly simple.
To calculate the increase that a target painter gives to the signature radius of an object, we use the following formula:
S = S0 * (100% + P)
Where S0 is the objects original signature radius, P the target painters signature increase bonus and S the final signature radius with the painter applied.

Please note that target painters are subject to stacking penalties and have a falloff range, please refer to sections 8 and 9 to see how these affect the effectiveness of multiple painters or when painters are used outside of their optimal range.

Modules/Rigs affecting:
Rigs:
Particle Dispersion Projector - 20% increase to optimal range for T1 version, 25% for T2.

Skills affecting:
Target Painting - 5% Reduction to capacitor need per skill level.
Signature Focusing - 5% bonus to effectiveness of target painters per skill level.
Long Distance Jamming - 10% bonus to optimal range per skill level.
Frequency Modulation - 10% bonus to falloff per skill level.

Specialized ships:
The target painting bonus is part of minmatar ships.
Vigil - Frigate, 5% bonus to target painter effectiveness per level.
Bellicose - Cruiser, 7.5% bonus to target painter effectiveness per level.
Huginn/Rapier - Recons, 7.5% bonus to target painter effectiveness per cruiser level.

Counters:
None

Examples:
Let's try to illustrate why target painting is sometimes useful.
A raven shoots a caracal with a torpedo.

A torpedo has an explosion radius of 400m.
A caracal has a signature radius of 145m.
Due to how missiles work, the torpedo does:
145/400 * 100% = 36.25% of it's normal damage.
If our torpedo would normally do 500 damage, it would now only do 181.25 damage

against the caracal.

Now, let's assume the raven is using two t2 target painters without any advanced skills on the caracal.
Signature radius bonus from one T2 target painter: 30%
Signature radius of Caracal with two target painters applied:
145m*(1+0.3)*(1+0.3*0.87) ~ 237.7m
Torpedo damage with two painters:
237.7/400 * 100% = 59.425% of normal damage.
If our torpedo did 500 damage, it would do ~ 297.1 damage after the painters have been applied, which is about 64% more damage than without the painters.

Of course, signature radius affects other things such as locking speed, turret tracking etc.

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7. Cap Draining (NOS/Neuts)

Short Description:
Cap draining with Nosferatus or Neutralizers reduces your targets cap and in some cases adds it to your own.

Methods of application:
Modules - NOS and Neuts are highslot modules, the main attributes of which are range, cap amount neutralized or drained and cycle time.
Drones - There are neutralizing drones available in various sizes.

Working Mechanism:
The mechanic for these is simple, each of them have a cycle time. Every cycle time seconds the cap amount is drained from the enemy.

There is a major difference between NOS and neuts however:
In case of NOS, the cap drained is added to your own, but only as long as you have less cap (percentually) than the ship you are draining cap from. Meaning that once you have (percentually) more cap than the target ship, no capacitor is drained from it anymore.

In the case of neuts you sacrifice a certain amount of energy but get a much bigger effect on the targets capacitor and it also removes energy from their capacitor when you have more energy than they do.

For efficient capacitor warfare it is smart to combine neutralizers and nosferatus.

Modules/rigs affecting:
None, however one should mention the existance of Talisman pirate implants.
These implants reduce the cycle time of your Nosferatu and Neutralizer modules.
According to Entity's Pirate Implants FAQ a lowgrade set will result in a 26.94% reduction and a highgrade set in a 38.12% reduction of module cycle time.

Skills affecting:
Energy Emission Systems - Decreases cap usage amount by 5% per level.

Specialized ships:
NOS-specialized ships come from the amarr and bloodraider races.
Curse - Amarr recon, Gets 20% bonus to cap amount transferred and 40% bonus to Nosferatu and Neutralizer range per recon skill level.
Pilgrim - Amarr recon, Gets 20% bonus to cap amount transferred per recon skill level.
Cruor - Blood Raider frigate, Gets 10% bonus to cap amount transferred per skill level.
Ashimmu - Blood Raider cruiser, Gets 10% bonus to cap amount transferred per skill level.
Bhaalgorn - Blood Raider battleship, Gets 10% bonus to cap amount transferred per skill level.

Counters:
There are no direct counters to nos, however, an indirect and viable counter is using a cap injector.

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8. Calculating chances with falloff.

Many of the EW modules have a falloff range.
A module has a 100% chance to hit from 0km to it's optimal range. At optimal+falloff the chance to hit drops to 50% and at optimal +2xfalloff it is 0%. This means that at optimal+falloff there is a 50% chance that the module will fail and not do anything.

To determine the chance of success in falloff range, we use the following formula:
C = 0.5^((R-O)/F)^2)
Where R is the range from you to the target, O the optimal range of the module, F the falloff range of the module and C the chance of success.
As a result, you will get a multiplier. This is a chance multiplier. In case of jammers, just multiply the calculated chance by it. In case of other modules, this will simply show you the chances of the module succeeding at a given range.

9. Calculating multipliers with stacking penalty.

A few of the EW modules are stacking penalized.
So if calculating the effect multiplier with multiple modules, you need to keep the stacking penalty in mind.
For calculating the multiplier we use the general stacking formula:
M = M1*S1*M2*S2*...*Mn*Sn
Where M(1..n) are the effect multipliers of module n and S(1..n) are stacking penalty multipliers for module n. Currently the stacking penalties for the first four modules are as following:
S(1) = 1
S(2) = 0.8708860
S(3) = 0.5705831
S(4) = 0.2829552

The formula to calculate the stacking penalty for the nth module is:
S(n) = 0.5^[((n-1) / 2.22292081) ^2]
Where n is the number of the module modifying the same attribute and S the stacking multiplier applied to that module.

Also keep in mind, that you need to sort the modules according to their strength in descending order. Meaning if you have 3 modules with different strengths, then the strongest module will suffer no stacking penalty and the weakest module will suffer the stacking penalty for the third module.

10. Conclusion

I hope this guide makes people better understand EW. Due to the length of it, I am really sure there are multiple spelling and perhaps factual mistakes. Any information regarding those will be appreciated and I will try to fix it as soon as humanly possible.

If you have any feedback, suggestions, questions or requests feel free to post them, I'll try to tend to them.