```
1/(((p1 - k1)^2) - (m^2)) + 1/(((p1 - k2)^2) - (m^2)) // Expand
```

$$\frac{1}{-m^2+\left(-k1+p1\right)^2}+\frac{1}{-m^2+\left(-k2+p1\right)^2}$$

```
(((p1 - k1)^2) + ((p1 - k2)^2) - (2 (m^2)))/(((((p1 - k1)^2) - (m^2)) (((p1 - k2)^2) - (m^2)))) // FullSimplify
```

$$\frac{-2\,m^2+\left(k1-p1\right)^2+\left(k2-p1\right)^2}{\left(-m^2+\left(k1-p1\right)^2\right)\left(-m^2+\left(k2-p1\right)^2\right)}$$

```
ZTransform[(-2 m^2 + (k1 - p1)^2 + (k2 - p1)^2)/((-m^2 + (k1 - p1)^2) (-m^2 + (k2 - p1)^2)), m, z]
```

$$\frac{1}{2\left(k1-p1\right)\left(-k2+p1\right)}\left(-k2\,\text{HurwitzLerchPhi}\left[\frac{1}{z},1,k1-p1\right]+p1\,\text{HurwitzLerchPhi}\left[\frac{1}{z},1,k1-p1\right]-k1\,\text{HurwitzLerchPhi}\left[\frac{1}{z},1,k2-p1\right]+p1\,\text{HurwitzLerchPhi}\left[\frac{1}{z},1,k2-p1\right]+k2\,\text{HurwitzLerchPhi}\left[\frac{1}{z},1,-k1+p1\right]-p1\,\text{HurwitzLerchPhi}\left[\frac{1}{z},1,-k1+p1\right]+k1\,\text{HurwitzLerchPhi}\left[\frac{1}{z},1,-k2+p1\right]-p1\,\text{HurwitzLerchPhi}\left[\frac{1}{z},1,-k2+p1\right]\right)$$

```
1/(((p1 - k1)^2) - (m^2)) + 1/(((p1 - k2)^2) - (m^2))
```

$$\frac{1}{-m^2+\left(-k1+p1\right)^2}+\frac{1}{-m^2+\left(-k2+p1\right)^2}$$

```
FourierSequenceTransform[1/(-m^2 + t^2) + 1/(-m^2 + u^2), m, ω] // FullSimplify
```

$$\frac{1}{2\,t\,u}\left(-u\,\text{HurwitzLerchPhi}\left[e^{-i\omega},1,-t\right]+u\,\text{HurwitzLerchPhi}\left[e^{-i\omega},1,t\right]+t\left(-\text{HurwitzLerchPhi}\left[e^{-i\omega},1,-u\right]+\text{HurwitzLerchPhi}\left[e^{-i\omega},1,u\right]\right)+e^{i\omega}\left(-u\,\text{HurwitzLerchPhi}\left[e^{i\omega},1,1-t\right]+u\,\text{HurwitzLerchPhi}\left[e^{i\omega},1,1+t\right]-t\,\text{HurwitzLerchPhi}\left[e^{i\omega},1,1-u\right]+t\,\text{HurwitzLerchPhi}\left[e^{i\omega},1,1+u\right]\right)\right)$$

```
((p1 - k1)^2) + ((p1 - k2)^2) - (2 (m^2)) // Expand // FullSimplify
(((p1 - k1)^2) - (m^2)) (((p1 - k2)^2) - (m^2)) // Expand // FullSimplify
```

$$k1^2+k2^2-2\,m^2-2\left(k1+k2\right)p1+2\,p1^2$$

$$-\left(k1-m-p1\right)\left(k1+m-p1\right)\left(k2+m-p1\right)\left(-k2+m+p1\right)$$

```
(k1 - m - p1) (k1 + m - p1) // Expand
```

$$k1^2-m^2-2\,k1\,p1+p1^2$$

```
(k1^2 + k2^2 - 2 m^2 - 2 (k1 + k2) p1 + 2 p1^2) /
 (-(k1 - m - p1) (k1 + m - p1) (k2 + m - p1) (-k2 + m + p1)) // FullSimplify
```

$$\frac{k1^2 + k2^2 - 2\,m^2 - 2\,(k1 + k2)\,p1 + 2\,p1^2}{(k1 + m - p1)\,(k2 + m - p1)\,(-k1 + m + p1)\,(-k2 + m + p1)}$$

```
(1/(((p1 - k1)^2) - (m^2)) + 1/(((p1 - k2)^2) - (m^2)))^2 // Expand // FullSimplify
```

$$\frac{\left(k1^2 + k2^2 - 2\,m^2 - 2\,(k1 + k2)\,p1 + 2\,p1^2\right)^2}{(k1 + m - p1)^2\,(k2 + m - p1)^2\,(-k1 + m + p1)^2\,(-k2 + m + p1)^2}$$

```
FourierTransform[1/(-m^2 + t^2) + 1/(-m^2 + u^2), m, ω] // FullSimplify
```

$$-\frac{1}{t\,u}\,i\,e^{-i\,(t+u)\,\omega}\,\sqrt{\frac{\pi}{2}}\,\left(e^{i\,u\,\omega}\,u\,\text{HeavisideTheta}[-\omega\,\text{Sign}[\text{Im}[t]]]\,\text{Sign}[\text{Im}[t]] + e^{i\,(2\,t+u)\,\omega}\,u\,\text{HeavisideTheta}[\omega\,\text{Sign}[\text{Im}[t]]]\,\text{Sign}[\text{Im}[t]] + e^{i\,t\,\omega}\,t\,\left(\text{HeavisideTheta}[-\omega\,\text{Sign}[\text{Im}[u]]] + e^{2\,i\,u\,\omega}\,\text{HeavisideTheta}[\omega\,\text{Sign}[\text{Im}[u]]]\right)\text{Sign}[\text{Im}[u]]\right)$$

```
(* u = t + k1 - k2 *)

F1 = -1/(t u) i e^(-i (t+u) ω) Sqrt[π/2] (e^(i u ω) u HeavisideTheta[-ω Sign[Im[t]]] Sign[Im[t]] +
     e^(i (2 t+u) ω) u HeavisideTheta[ω Sign[Im[t]]] Sign[Im[t]] +
     e^(i t ω) t (HeavisideTheta[-ω Sign[Im[u]]] + e^(2 i u ω) HeavisideTheta[ω Sign[Im[u]]])
      Sign[Im[u]]) /. u → t + k1 - k2;

F2 = Assuming[{a ∈ Reals, b ∈ Reals}, F1 /. t → a + b i] // Simplify;

Abs[F2] // Simplify
```

$$e^{\text{Im}[(2\,a+2\,i\,b+k1-k2)\,\omega]}\,\sqrt{\frac{\pi}{2}}$$

$$\text{Abs}\Big[\frac{1}{(a + i\,b)\,(a + i\,b + k1 - k2)}\,\left(e^{i\,(a+i\,b+k1-k2)\,\omega}\,(a + i\,b + k1 - k2)\,\text{HeavisideTheta}[-\omega\,\text{Sign}[\text{Im}[a] + \text{Re}[b]]]\,\text{Sign}[\text{Im}[a] + \text{Re}[b]] + e^{i\,(3\,a+3\,i\,b+k1-k2)\,\omega}\,(a + i\,b + k1 - k2)\,\text{HeavisideTheta}[\omega\,\text{Sign}[\text{Im}[a] + \text{Re}[b]]]\,\text{Sign}[\text{Im}[a] + \text{Re}[b]] + (a + i\,b)\,e^{i\,(a+i\,b)\,\omega}\,\left(\text{HeavisideTheta}[-\omega\,\text{Sign}[\text{Im}[a + k1 - k2] + \text{Re}[b]]] + e^{2\,i\,(a+i\,b+k1-k2)\,\omega}\,\text{HeavisideTheta}[\omega\,\text{Sign}[\text{Im}[a + k1 - k2] + \text{Re}[b]]]\right)\text{Sign}[\text{Im}[a + k1 - k2] + \text{Re}[b]]\right)\Big]$$

```
F2Num = Abs[F2 /. k1 → .1 /. k2 → .3 /. a → 0 /. b → .00005] // Simplify;
Plot[{F2Num}, {ω, 0, 1000}]
```