In [8]:
```
import numpy as np
import torch
import pandas as pd
import time
import operator
import statsmodels.api as sm
import matplotlib.pyplot as plt
from datetime import datetime
import torch.nn as nn
import torch.nn.functional as F
from torch.utils.data import TensorDataset, DataLoader
from sklearn import preprocessing
# from sklearn.preprocessing import StandardScaler
CONVERSION_MAP = {0:'00',1:'01',2:'02',3:'03',4:'04',5:'05',6:'06',7:'07',8:'08',9:'09'}
start_time = time.time()
research_date = range(1,13)

# 在bitmex上挂单

bitmex_maker = -0.00025
bitmex_taker = 0.00075

# 在okex上吃单
okex_maker = -0.0001
okex_taker = 0.0002
```

In [9]:
```
list1 = []
list2 = []
for date in research_date:
    date_str = CONVERSION_MAP[date] if date in CONVERSION_MAP else str(date)
    list1.append(pd.read_csv('/Users/dear/Desktop/Pythagoras/PC/Depth_201909'+date_str+'_btc_usd.csv',index_col ='LastUpdateId'
, usecols = ['BidsPrice1', 'AsksPrice1','LastUpdateId']))
    list2.append(pd.read_csv('/Users/dear/Desktop/Pythagoras/Q/Depth_201909'+date_str+'_btc_usd.csv',index_col ='LastUpdateId',
usecols =['BidsPrice1', 'AsksPrice1','LastUpdateId']))

excel_file_input1 = pd.concat(list1)
excel_file_input2 = pd.concat(list2)
excel_file_input3 = pd.read_csv('/Users/dear/Desktop/Pythagoras/Funding History  2019-10-30.csv', usecols = ['symbol', 'funding
Rate', 'timestamp'])
```

In [10]:
```
excel_file_input3['timestamp'] = [datetime.strptime(i,'%Y-%m-%dT%H:%M:%S.%fZ').strftime("%s") for i in excel_file_input3['times
tamp']]
excel_file_input3['funding_timestamp'] = excel_file_input3['timestamp'].astype(int)
excel_file_input3['timestamp'] = excel_file_input3['timestamp'].astype(int)-8*60*60
excel_file_input3.drop(excel_file_input3[excel_file_input3['symbol'] != 'XBTUSD' ].index, inplace=True)
excel_file_input3 = excel_file_input3.drop(['symbol'], axis =1)
excel_file_input3 = excel_file_input3.set_index('timestamp')

excel_file_input1.index = (excel_file_input1.index/1000).astype(int)
excel_file_input2.index = (excel_file_input2.index/1000).astype(int)
excel_file_input1=excel_file_input1.reset_index().drop_duplicates(subset='LastUpdateId', keep='first').set_index('LastUpdateId'
)
excel_file_input2=excel_file_input2.reset_index().drop_duplicates(subset='LastUpdateId', keep='first').set_index('LastUpdateId'
)

excel_file_input1 = excel_file_input1.rename(columns={"BidsPrice1": "bid_price_bitmex", "AsksPrice1": "ask_price_bitmex"})
excel_file_input2 = excel_file_input2.rename(columns={"BidsPrice1": "bid_price_okex", "AsksPrice1": "ask_price_okex"})
excel_file_input2['contract_exp'] = (1569571200 - excel_file_input2.index)
```

In [11]:
```
final_input = pd.merge(excel_file_input1, excel_file_input2, left_index = True, right_index = True, how='outer')
final_input = final_input.join(excel_file_input3)
for item in final_input.columns:
    final_input[item] = final_input[item].interpolate(method='pad')
final_input['funding_exp'] = final_input['funding_timestamp']-final_input.index
final_input = final_input.drop(['funding_timestamp'], axis =1)
final_input = final_input.dropna()
```

In [12]:
```
final_input.head(40)
```

Out[12]:

LastUpdateId	bid_price_bitmex	ask_price_bitmex	bid_price_okex	ask_price_okex	contract_exp	fundingRate	funding_exp
1567339200	9585.0	9585.5	9634.83	9634.84	2232000.0	0.0001	28800.0
1567339201	9585.0	9585.5	9634.83	9634.84	2231999.0	0.0001	28799.0
1567339202	9585.0	9585.5	9634.83	9634.84	2231998.0	0.0001	28798.0
1567339203	9585.0	9585.5	9634.83	9634.84	2231997.0	0.0001	28797.0
1567339204	9585.0	9585.5	9634.83	9634.84	2231996.0	0.0001	28796.0
1567339205	9585.0	9585.5	9634.83	9634.84	2231995.0	0.0001	28795.0
1567339206	9585.0	9585.5	9634.83	9634.84	2231994.0	0.0001	28794.0
1567339207	9585.0	9585.5	9634.83	9634.84	2231993.0	0.0001	28793.0
1567339208	9585.0	9585.5	9634.83	9634.84	2231992.0	0.0001	28792.0
1567339209	9585.0	9585.5	9634.83	9634.84	2231991.0	0.0001	28791.0
1567339210	9585.0	9585.5	9634.83	9634.84	2231990.0	0.0001	28790.0
1567339211	9585.0	9585.5	9634.83	9634.84	2231989.0	0.0001	28789.0
1567339212	9585.0	9585.5	9634.83	9634.84	2231988.0	0.0001	28788.0
1567339213	9585.0	9585.5	9634.83	9634.84	2231987.0	0.0001	28787.0
1567339214	9585.0	9585.5	9634.83	9634.84	2231986.0	0.0001	28786.0
1567339215	9585.0	9585.5	9634.83	9634.84	2231985.0	0.0001	28785.0
1567339216	9585.0	9585.5	9634.83	9634.84	2231984.0	0.0001	28784.0
1567339217	9585.0	9585.5	9634.83	9634.84	2231983.0	0.0001	28783.0
1567339218	9585.0	9585.5	9634.83	9634.84	2231982.0	0.0001	28782.0
1567339219	9585.0	9585.5	9634.83	9634.84	2231981.0	0.0001	28781.0
1567339220	9585.0	9585.5	9634.83	9634.84	2231980.0	0.0001	28780.0
1567339221	9585.0	9585.5	9634.83	9634.84	2231979.0	0.0001	28779.0
1567339222	9585.0	9585.5	9634.83	9634.84	2231978.0	0.0001	28778.0
1567339223	9584.0	9584.5	9634.83	9634.84	2231977.0	0.0001	28777.0
1567339224	9583.0	9583.5	9632.18	9632.19	2231976.0	0.0001	28776.0
1567339225	9581.0	9581.5	9632.17	9632.18	2231975.0	0.0001	28775.0
1567339226	9581.0	9581.5	9632.17	9632.18	2231974.0	0.0001	28774.0
1567339227	9581.0	9581.5	9632.17	9632.18	2231973.0	0.0001	28773.0
1567339228	9581.0	9581.5	9632.17	9632.18	2231972.0	0.0001	28772.0
1567339229	9581.0	9581.5	9632.17	9632.18	2231971.0	0.0001	28771.0
1567339230	9581.0	9581.5	9631.55	9631.56	2231970.0	0.0001	28770.0
1567339231	9581.0	9581.5	9631.00	9631.01	2231969.0	0.0001	28769.0
1567339232	9581.0	9581.5	9631.00	9631.01	2231968.0	0.0001	28768.0
1567339233	9580.5	9581.0	9631.00	9631.01	2231967.0	0.0001	28767.0
1567339234	9580.0	9580.5	9631.00	9631.01	2231966.0	0.0001	28766.0
1567339235	9580.0	9580.5	9631.00	9631.01	2231965.0	0.0001	28765.0
1567339236	9580.0	9580.5	9631.00	9631.01	2231964.0	0.0001	28764.0
1567339237	9580.0	9580.5	9631.00	9631.01	2231963.0	0.0001	28763.0
1567339238	9580.0	9580.5	9631.00	9631.01	2231962.0	0.0001	28762.0
1567339239	9580.0	9580.5	9631.00	9631.01	2231961.0	0.0001	28761.0

In [14]:
```
final_input['mid_spread'] = (final_input['bid_price_okex']+final_input['ask_price_okex'])/2-(final_input['bid_price_bitmex']+fi
nal_input['ask_price_bitmex'])/2
final_input['mid_spread_adjusted'] = final_input['mid_spread']
final_input['mid_spread_adjusted'][final_input['funding_exp']<14400] = final_input['mid_spread']-final_input['fundingRate']*fin
al_input['bid_price_bitmex']*(1-final_input['funding_exp']/28800)
```

In [18]:
```
final_input['mid_spread_adjusted_ma'] = final_input['mid_spread_adjusted'].rolling(window=12*60*60).mean()
final_input['mid_spread_adjusted_diff'] = final_input['mid_spread_adjusted']-final_input['mid_spread_adjusted_ma']
final_input['mid_spread_adjusted_std'] = final_input['mid_spread_adjusted_diff'].rolling(window=24*60*60).std()
final_input['mid_spread_adjusted_zscore'] = final_input['mid_spread_adjusted_diff']/final_input['mid_spread_adjusted_std']
```

In [19]:
```
# 给出交易信号signal

final_input['signal'] = 0
final_input['signal'][final_input['mid_spread_adjusted_zscore'] > 1] = -0.01
final_input['signal'][final_input['mid_spread_adjusted_zscore'] < -1] = 0.01
```

```
/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:4: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ve
rsus-a-copy
  after removing the cwd from sys.path.
```

In [21]:
```
# 在某些条件下，根据信号计算position

final_input['position'] = 0
for i in range(2, len(final_input)):
    if final_input['mid_spread'].iloc[i] <= 0 and final_input['position'].iloc[i-1] <= 0:
        final_input['position'].iloc[i] = min(max(final_input['position'].iloc[i-1] + final_input['signal'].iloc[i],final_input
['position'].iloc[i-1]),100)
    if final_input['mid_spread'].iloc[i] >= 0 and final_input['position'].iloc[i-1] >= 0:
        final_input['position'].iloc[i] = min(max(final_input['position'].iloc[i-1] + final_input['signal'].iloc[i],-100),final
_input['position'].iloc[i-1])
    else:
        final_input['position'].iloc[i] = min(max(final_input['position'].iloc[i-1] + final_input['signal'].iloc[i],-100),100)

# 前后position的差值，表示发生的交易的量
final_input['transction'] = final_input['position']-final_input['position'].shift(1)
final_input.head(40)
```

Out[21]:

LastUpdateId	bid_price_bitmex	ask_price_bitmex	bid_price_okex	ask_price_okex	contract_exp	fundingRate	funding_exp	mid_spread	mid_spread_adjusted	mid_spread_ad
1567339200	9585.0	9585.5	9634.83	9634.84	2232000.0	0.0001	28800.0	49.585	49.585	
1567339201	9585.0	9585.5	9634.83	9634.84	2231999.0	0.0001	28799.0	49.585	49.585	
1567339202	9585.0	9585.5	9634.83	9634.84	2231998.0	0.0001	28798.0	49.585	49.585	
1567339203	9585.0	9585.5	9634.83	9634.84	2231997.0	0.0001	28797.0	49.585	49.585	
1567339204	9585.0	9585.5	9634.83	9634.84	2231996.0	0.0001	28796.0	49.585	49.585	
1567339205	9585.0	9585.5	9634.83	9634.84	2231995.0	0.0001	28795.0	49.585	49.585	
1567339206	9585.0	9585.5	9634.83	9634.84	2231994.0	0.0001	28794.0	49.585	49.585	
1567339207	9585.0	9585.5	9634.83	9634.84	2231993.0	0.0001	28793.0	49.585	49.585	
1567339208	9585.0	9585.5	9634.83	9634.84	2231992.0	0.0001	28792.0	49.585	49.585	
1567339209	9585.0	9585.5	9634.83	9634.84	2231991.0	0.0001	28791.0	49.585	49.585	
1567339210	9585.0	9585.5	9634.83	9634.84	2231990.0	0.0001	28790.0	49.585	49.585	
1567339211	9585.0	9585.5	9634.83	9634.84	2231989.0	0.0001	28789.0	49.585	49.585	
1567339212	9585.0	9585.5	9634.83	9634.84	2231988.0	0.0001	28788.0	49.585	49.585	
1567339213	9585.0	9585.5	9634.83	9634.84	2231987.0	0.0001	28787.0	49.585	49.585	
1567339214	9585.0	9585.5	9634.83	9634.84	2231986.0	0.0001	28786.0	49.585	49.585	
1567339215	9585.0	9585.5	9634.83	9634.84	2231985.0	0.0001	28785.0	49.585	49.585	
1567339216	9585.0	9585.5	9634.83	9634.84	2231984.0	0.0001	28784.0	49.585	49.585	
1567339217	9585.0	9585.5	9634.83	9634.84	2231983.0	0.0001	28783.0	49.585	49.585	
1567339218	9585.0	9585.5	9634.83	9634.84	2231982.0	0.0001	28782.0	49.585	49.585	
1567339219	9585.0	9585.5	9634.83	9634.84	2231981.0	0.0001	28781.0	49.585	49.585	
1567339220	9585.0	9585.5	9634.83	9634.84	2231980.0	0.0001	28780.0	49.585	49.585	
1567339221	9585.0	9585.5	9634.83	9634.84	2231979.0	0.0001	28779.0	49.585	49.585	
1567339222	9585.0	9585.5	9634.83	9634.84	2231978.0	0.0001	28778.0	49.585	49.585	
1567339223	9584.0	9584.5	9634.83	9634.84	2231977.0	0.0001	28777.0	50.585	50.585	
1567339224	9583.0	9583.5	9632.18	9632.19	2231976.0	0.0001	28776.0	48.935	48.935	
1567339225	9581.0	9581.5	9632.17	9632.18	2231975.0	0.0001	28775.0	50.925	50.925	
1567339226	9581.0	9581.5	9632.17	9632.18	2231974.0	0.0001	28774.0	50.925	50.925	
1567339227	9581.0	9581.5	9632.17	9632.18	2231973.0	0.0001	28773.0	50.925	50.925	
1567339228	9581.0	9581.5	9632.17	9632.18	2231972.0	0.0001	28772.0	50.925	50.925	
1567339229	9581.0	9581.5	9632.17	9632.18	2231971.0	0.0001	28771.0	50.925	50.925	
1567339230	9581.0	9581.5	9631.55	9631.56	2231970.0	0.0001	28770.0	50.305	50.305	
1567339231	9581.0	9581.5	9631.00	9631.01	2231969.0	0.0001	28769.0	49.755	49.755	
1567339232	9581.0	9581.5	9631.00	9631.01	2231968.0	0.0001	28768.0	49.755	49.755	
1567339233	9580.5	9581.0	9631.00	9631.01	2231967.0	0.0001	28767.0	50.255	50.255	
1567339234	9580.0	9580.5	9631.00	9631.01	2231966.0	0.0001	28766.0	50.755	50.755	
1567339235	9580.0	9580.5	9631.00	9631.01	2231965.0	0.0001	28765.0	50.755	50.755	
1567339236	9580.0	9580.5	9631.00	9631.01	2231964.0	0.0001	28764.0	50.755	50.755	
1567339237	9580.0	9580.5	9631.00	9631.01	2231963.0	0.0001	28763.0	50.755	50.755	
1567339238	9580.0	9580.5	9631.00	9631.01	2231962.0	0.0001	28762.0	50.755	50.755	
1567339239	9580.0	9580.5	9631.00	9631.01	2231961.0	0.0001	28761.0	50.755	50.755	

In [23]:
```
final_input['transction'].abs().sum()
```

Out[23]:
```
1470.0900000002152
```

In [24]:
```
final_input.fundingRate.min()
```

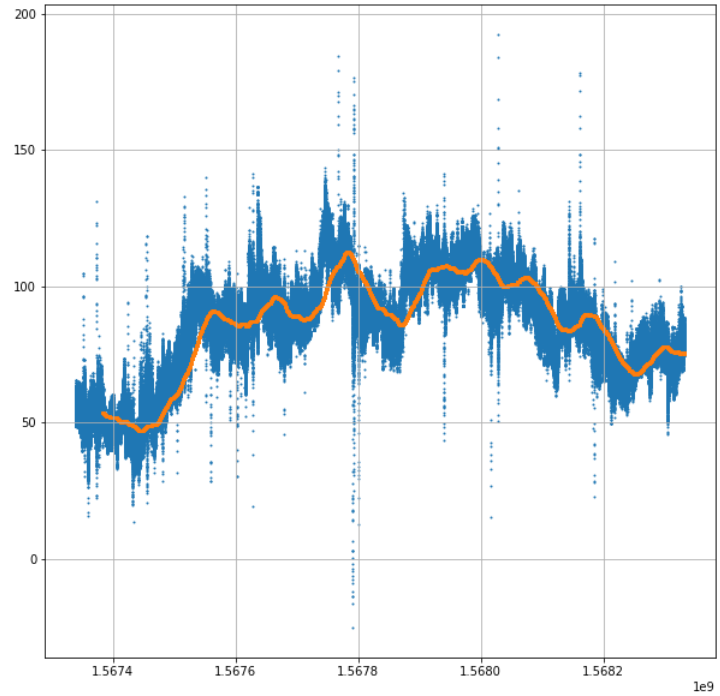
Out[24]:
```
3.2e-05
```

In [25]:
```
final_input['usd_transaction'] = 0
final_input['funding_transaction'] = 0
final_input['bitmex_position'] = 0
final_input['okex_position'] = 0
final_input['usd_position'] = 0
final_input['net_worth'] = 0


final_input['bitmex_transaction'] = - final_input['transction']
final_input['okex_transaction'] = final_input['transction']
# transaction>0, 先在bitmex上挂卖单，再去okex吃买单
final_input['usd_transaction'][final_input['transction']>0] = (final_input['ask_price_bitmex']*(1-bitmex_maker)-final_input['ask_price_okex']*(1+okex_taker))*0.01
# transaction<0, 先在bitmex上挂买单，再去okex吃卖单
final_input['usd_transaction'][final_input['transction']<0] = (final_input['bid_price_okex']*(1-okex_taker)-final_input['bid_price_bitmex']*(1+bitmex_maker))*0.01
# 计算两边的仓位
final_input['bitmex_position'] = final_input['bitmex_transaction'].rolling(min_periods=1,window=len(final_input)).sum()
final_input['okex_position'] = final_input['okex_transaction'].rolling(min_periods=1,window=len(final_input)).sum()
# funding金额为bitmex仓位 x price x funding rate
final_input['funding_transaction'][final_input['funding_exp']==1] = -(final_input['fundingRate'] * final_input['bitmex_position']*final_input['ask_price_bitmex'])
final_input['funding_payment'] = final_input['funding_transaction'].rolling(min_periods=1,window=len(final_input)).sum()

final_input['usd_position'] = final_input['usd_transaction'].rolling(min_periods=1,window=len(final_input)).sum()+final_input['funding_payment']
final_input['net_worth'][final_input['position']>0] = final_input['position']*(final_input['bid_price_okex']*(1-okex_taker)-final_input['bid_price_bitmex']*(1+bitmex_maker))+final_input['usd_position']+1000000
final_input['net_worth'][final_input['position']<0] = -final_input['position']*(final_input['ask_price_bitmex']*(1-bitmex_maker)-final_input['ask_price_okex']*(1+okex_taker))+final_input['usd_position']+1000000
final_input['net_worth'][final_input['position']==0] = final_input['usd_position']+1000000
```

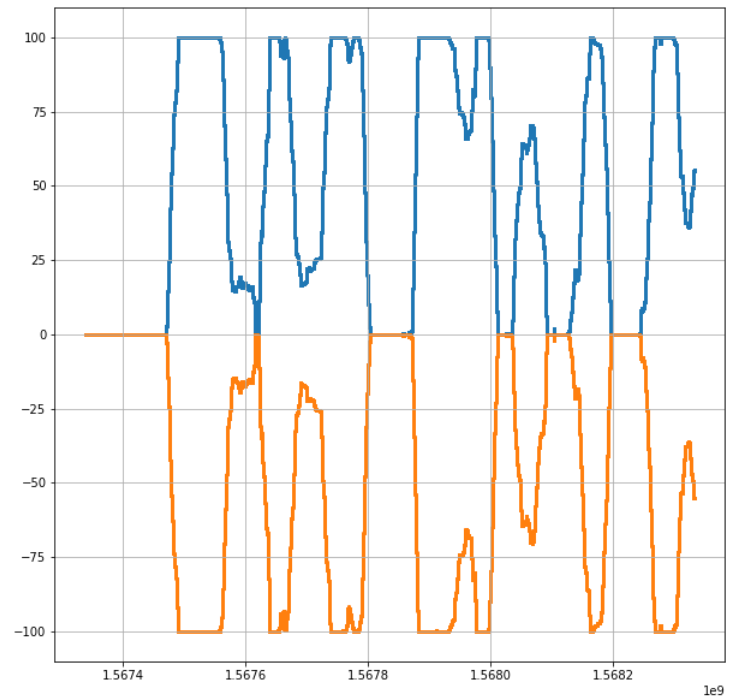
```
/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:12: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  if sys.path[0] == '':
/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:14: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy

/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:19: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:23: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
```

In [26]:
```
final_input['drawdown'] = (final_input['net_worth'].rolling(min_periods=1,window=len(final_input)).max()-final_input['net_worth'])/final_input['net_worth'].rolling(min_periods=1,window=len(final_input)).max()
final_input['transaction_amount'] = final_input['transction'].abs().rolling(min_periods=1,window=len(final_input)).sum()
final_input['profit_per_trade'] = (final_input['net_worth']-1000000)/final_input['transaction_amount']/final_input['ask_price_bitmex']
```

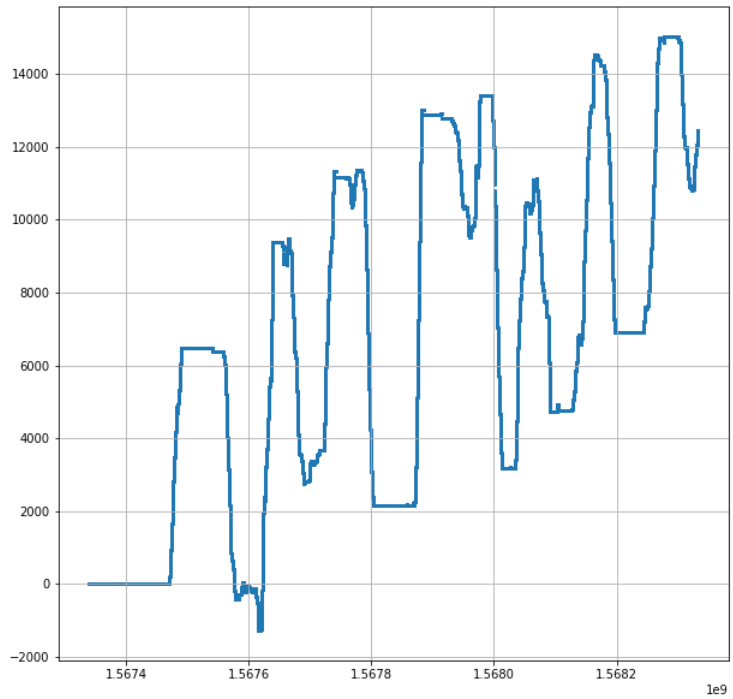
In [28]:
```
plt.ion()
plt.figure(figsize = (10,10))
plt.grid(True)
plt.scatter(final_input.index, final_input['mid_spread_adjusted'],s=1)
plt.scatter(final_input.index, final_input['mid_spread_adjusted_ma'],s=1)
plt.show()
```



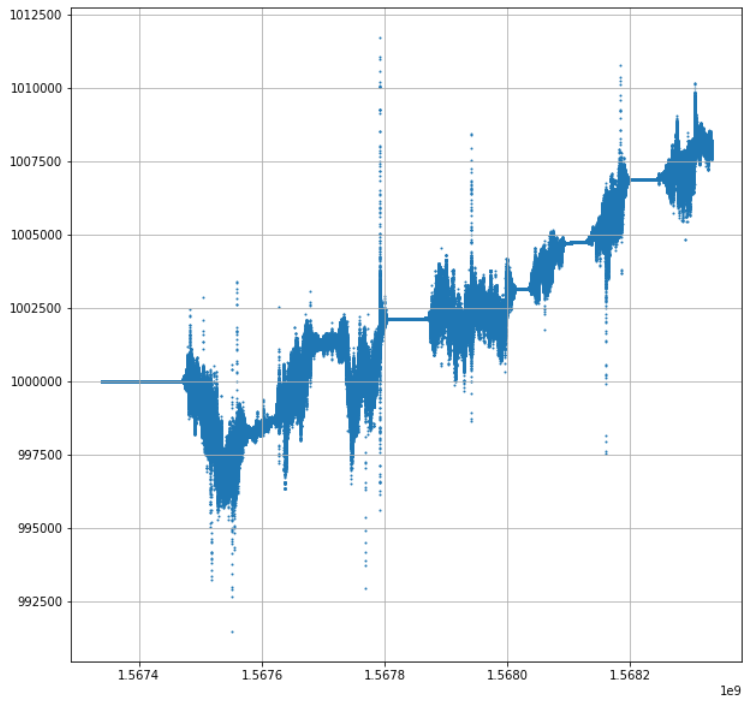
In [29]:
```
plt.ion()
plt.figure(figsize = (10,10))
plt.grid(True)
plt.scatter(final_input.index, final_input['bitmex_position'],s=1)
plt.scatter(final_input.index, final_input['okex_position'],s=1)
plt.show()
```



In [30]:
```
plt.ion()
plt.figure(figsize = (10,10))
plt.grid(True)
plt.scatter(final_input.index, final_input['usd_position'],s=1)
plt.show()
```



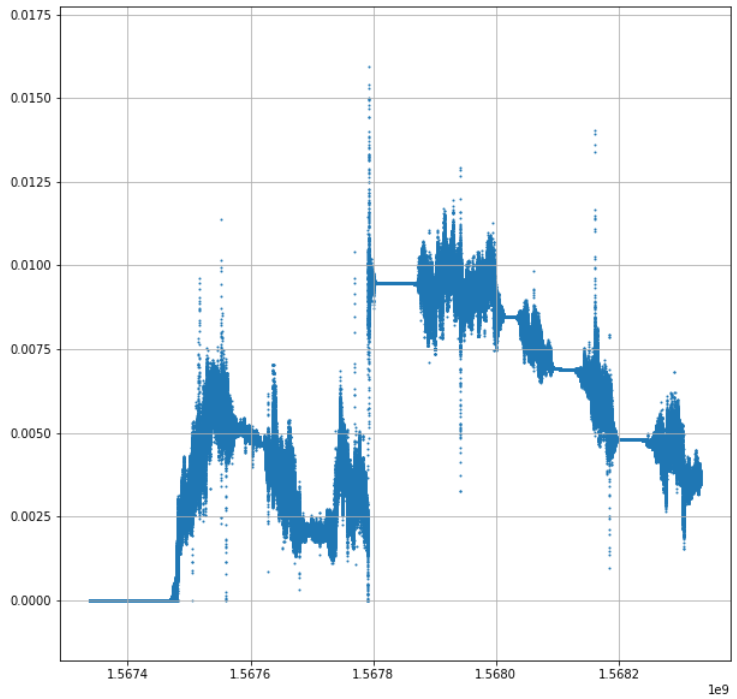
In [31]:
```
plt.ion()
plt.figure(figsize = (10,10))
plt.grid(True)
plt.scatter(final_input.index, final_input['net_worth'],s=1)
plt.show()
```



In [34]:
```
final_input['net_worth'].iloc[-1]
```

Out[34]: 1008170.2447606373

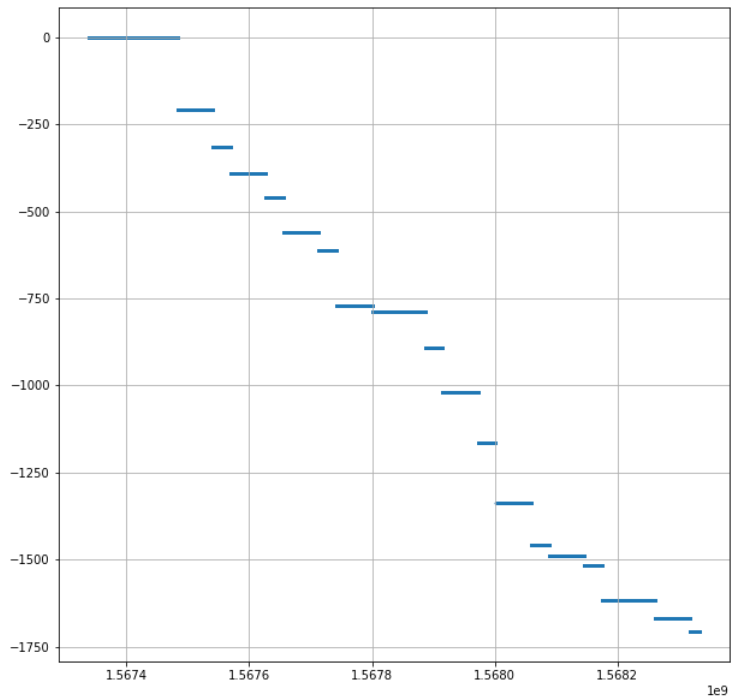
In [32]:
```
plt.ion()
plt.figure(figsize = (10,10))
plt.grid(True)
plt.scatter(final_input.index, final_input['drawdown'],s=1)
plt.show()
```



In [ ]:
```
plt.ion()
plt.figure(figsize = (10,10))
plt.grid(True)
plt.scatter(final_input.index, final_input['transaction_amount'],s=1)
plt.show()
```

In [ ]:
```
plt.ion()
plt.figure(figsize = (10,10))
plt.grid(True)
plt.scatter(final_input.index, final_input['profit_per_trade'],s=1)
plt.show()
```

In [33]:
```
plt.ion()
plt.figure(figsize = (10,10))
plt.grid(True)
plt.scatter(final_input.index, final_input['funding_payment'],s=1)
plt.show()
```



In [539]:
```
print((len(final_input)-12*60*60-24*60*60)/60/60/24)
```

```
9.997511574074073
```