In [2]:
```
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)
bitmex_maker = -0.00025
bitmex_taker = 0.00075
okex_maker = -0.0001
okex_taker = 0.0002
```

In [3]:
```
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 [4]:
```
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)

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 [5]:
```
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_ma'] = final_input['mid_spread'].rolling(window=12*60*60).mean()
final_input['mid_spread_diff'] = final_input['mid_spread']-final_input['mid_spread_ma']
final_input['mid_spread_std'] = final_input['mid_spread_diff'].rolling(window=24*60*60).std()
final_input['mid_spread_zscore'] = final_input['mid_spread_diff']/final_input['mid_spread_std']

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

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)
final_input['transction'] = final_input['position']-final_input['position'].shift(1)


print(final_input)
```

```
/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:8: 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

/opt/anaconda3/lib/python3.7/site-packages/pandas/core/indexing.py:205: 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
  self._setitem_with_indexer(indexer, value)

              bid_price_bitmex  ask_price_bitmex  bid_price_okex  \
LastUpdateId
1567339200              9585.0            9585.5         9634.83
1567339201              9585.0            9585.5         9634.83
1567339202              9585.0            9585.5         9634.83
1567339203              9585.0            9585.5         9634.83
1567339204              9585.0            9585.5         9634.83
...                        ...               ...             ...
1568332795             10433.5           10434.0        10511.99
1568332796             10433.5           10434.0        10511.99
1568332797             10433.5           10434.0        10511.99
1568332798             10433.5           10434.0        10511.99
1568332799             10433.5           10434.0        10511.99

              ask_price_okex  contract_exp  fundingRate  funding_exp  \
LastUpdateId
1567339200           9634.84     2232000.0     0.000100      28800.0
1567339201           9634.84     2231999.0     0.000100      28799.0
1567339202           9634.84     2231998.0     0.000100      28798.0
1567339203           9634.84     2231997.0     0.000100      28797.0
1567339204           9634.84     2231996.0     0.000100      28796.0
...                      ...           ...          ...          ...
1568332795          10512.00     1238405.0     0.000102      14405.0
1568332796          10512.00     1238404.0     0.000102      14404.0
1568332797          10512.00     1238403.0     0.000102      14403.0
1568332798          10512.00     1238402.0     0.000102      14402.0
1568332799          10512.00     1238401.0     0.000102      14401.0

              mid_spread  mid_spread_ma  mid_spread_diff  mid_spread_std  \
LastUpdateId
1567339200        49.585            NaN              NaN             NaN
1567339201        49.585            NaN              NaN             NaN
1567339202        49.585            NaN              NaN             NaN
1567339203        49.585            NaN              NaN             NaN
1567339204        49.585            NaN              NaN             NaN
...                  ...            ...              ...             ...
1568332795        78.245      75.805059         2.439941        6.510759
1568332796        78.245      75.804995         2.440005        6.510753
1568332797        78.245      75.804931         2.440069        6.510747
1568332798        78.245      75.804867         2.440133        6.510740
1568332799        78.245      75.804804         2.440196        6.510734

              mid_spread_zscore  signal  position  transction
LastUpdateId
1567339200                  NaN     0.0      0.00         NaN
1567339201                  NaN     0.0      0.00         0.0
1567339202                  NaN     0.0      0.00         0.0
1567339203                  NaN     0.0      0.00         0.0
1567339204                  NaN     0.0      0.00         0.0
...                         ...     ...       ...         ...
1568332795             0.374755     0.0    -52.48         0.0
1568332796             0.374765     0.0    -52.48         0.0
1568332797             0.374776     0.0    -52.48         0.0
1568332798             0.374786     0.0    -52.48         0.0
1568332799             0.374796     0.0    -52.48         0.0

[993385 rows x 15 columns]
```

In [529]:
```
print(final_input['transction'].abs().sum())
```

```
1464.7000000001997
```

In [6]:
```
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']
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
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
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()
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
```

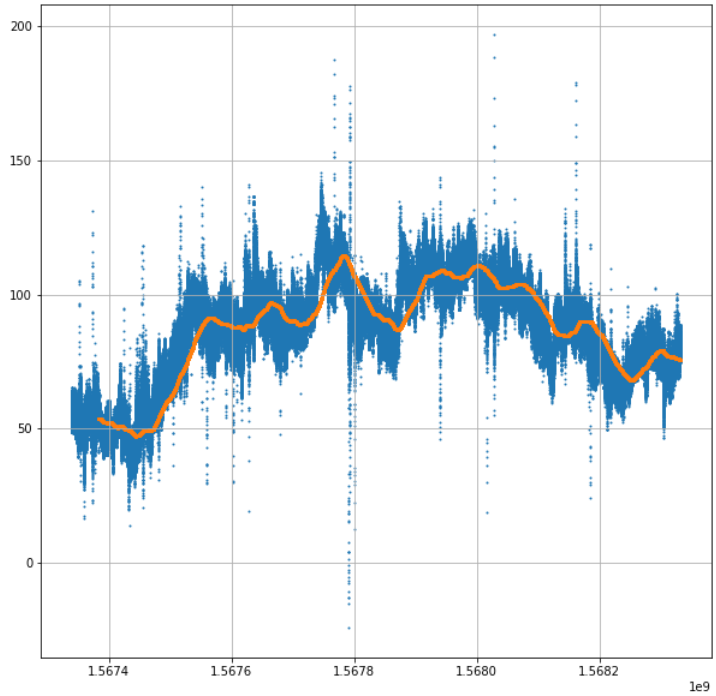
```
/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:10: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  # Remove the CWD from sys.path while we load stuff.
/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:11: 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
  # This is added back by InteractiveShellApp.init_path()
/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:17: 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 [7]:
```
final_input['net_worth'].iloc[-1]
```

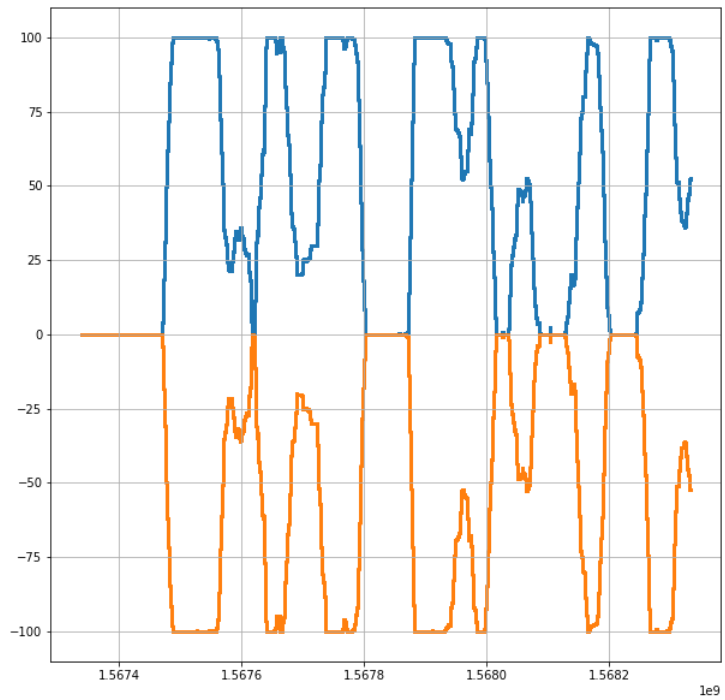
Out[7]:
```
1008257.0925532168
```

In [531]:
```
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']
```

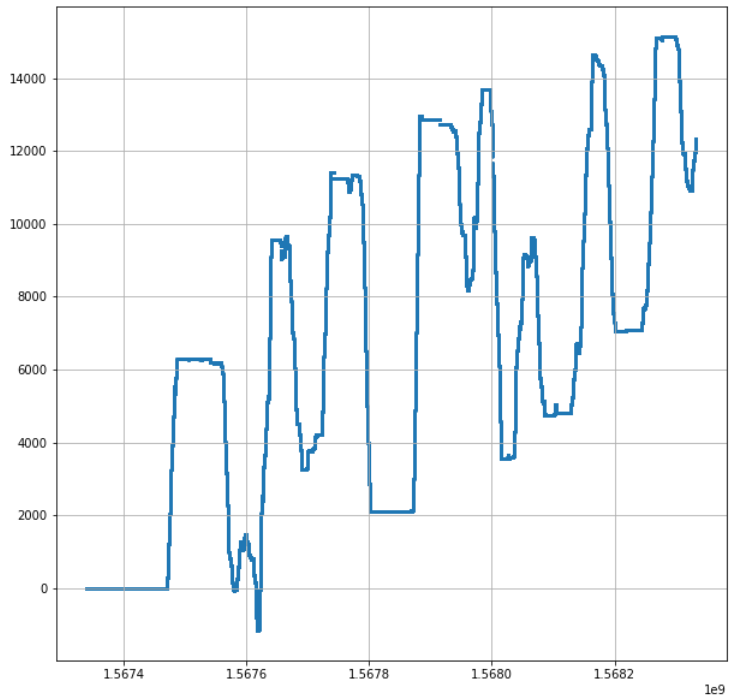
In [532]:
```
plt.ion()
plt.figure(figsize = (10,10))
plt.grid(True)
plt.scatter(final_input.index, final_input['mid_spread'],s=1)
plt.scatter(final_input.index, final_input['mid_spread_ma'],s=1)
plt.show()
```



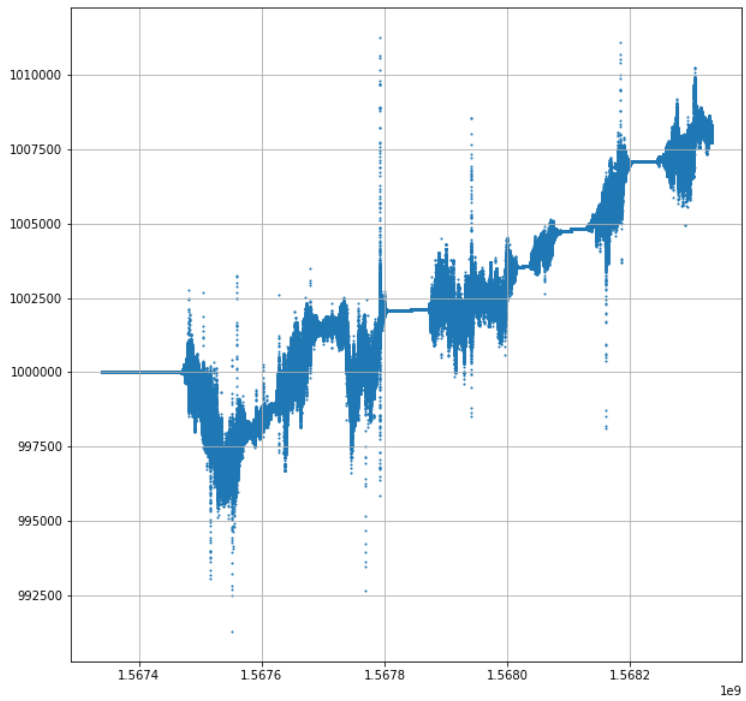
In [533]:
```
plt.ion()
plt.figure(figsize = (10,10))
plt.grid(True)
plt.scatter(final_input.index, final_input['bitmex_position'],s=1)
plt.scatter(final_input.index, final_input['okex_position'],s=1)
plt.show()
```



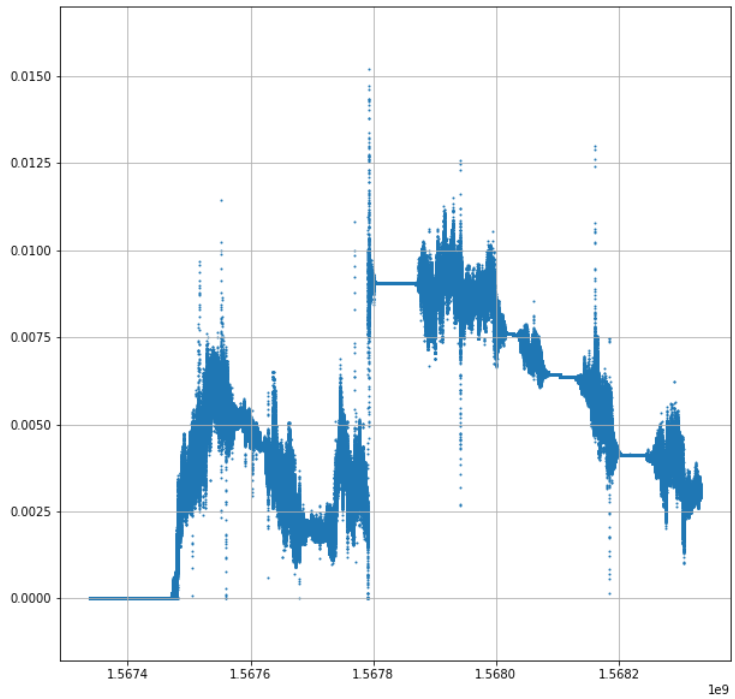
In [534]:
```
plt.ion()
plt.figure(figsize = (10,10))
plt.grid(True)
plt.scatter(final_input.index, final_input['usd_position'],s=1)
plt.show()
```



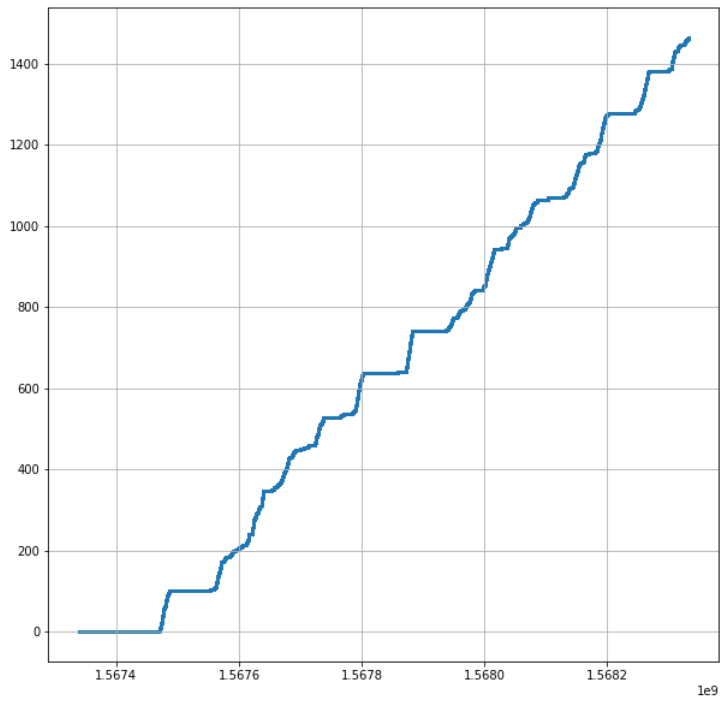
In [535]:
```
plt.ion()
plt.figure(figsize = (10,10))
plt.grid(True)
plt.scatter(final_input.index, final_input['net_worth'],s=1)
plt.show()
```



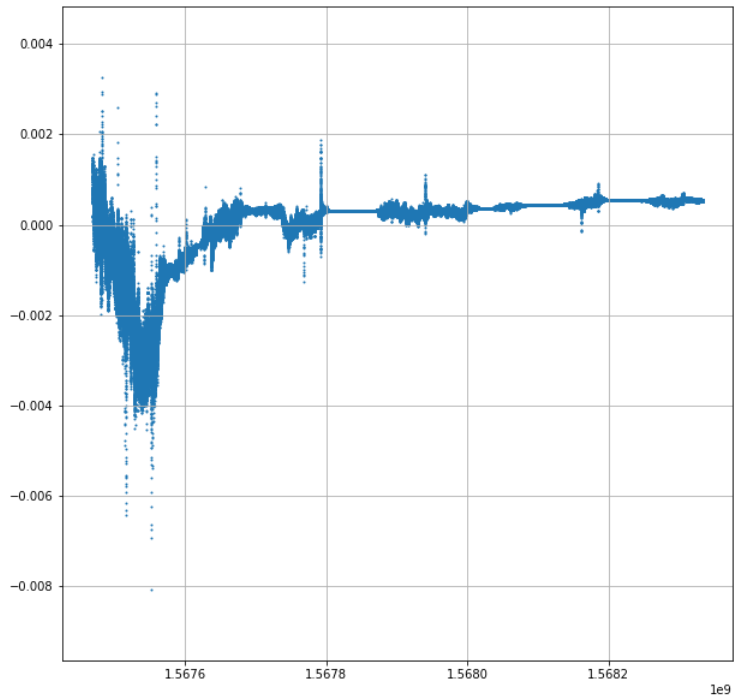
In [536]:
```
plt.ion()
plt.figure(figsize = (10,10))
plt.grid(True)
plt.scatter(final_input.index, final_input['drawdown'],s=1)
plt.show()
```



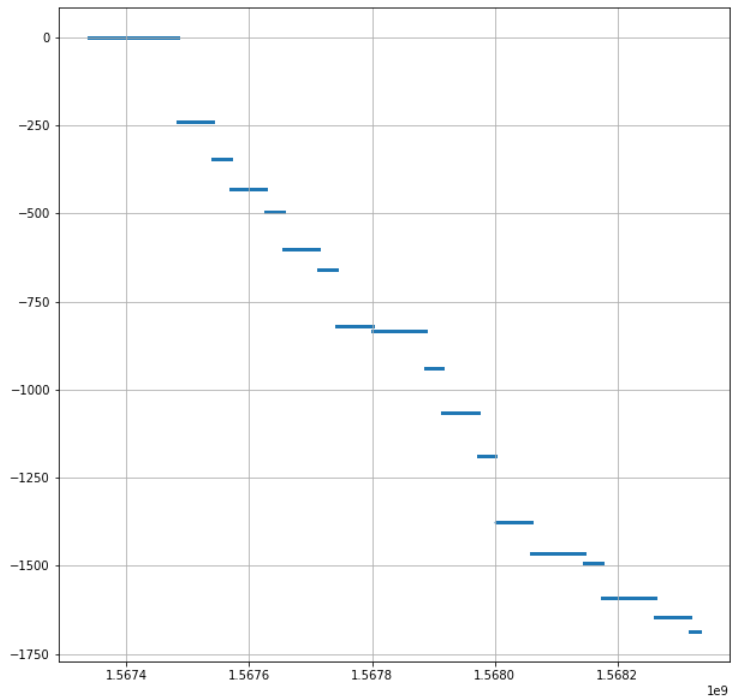
In [537]:
```
plt.ion()
plt.figure(figsize = (10,10))
plt.grid(True)
plt.scatter(final_input.index, final_input['transaction_amount'],s=1)
plt.show()
```



In [538]:
```
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 [540]:
```
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
```

In [ ]: