Nasdaq Calypso

Pricing Script

Version 18

Revision 2.0

June 2024

Approved

Document History

Revision	Published	Summary of Changes
1.0	February 2024	First revision for version 18.
2.0	June 2024	Updates for monthly release - Added default values in meta data.

A Pricing Script can be used for exotic modeling of Equity Structured Options, Bond Exotic Notes, and various product types in the Pricing Sheet. The Pricing Script allows defining event based payoffs and features difficult to capture as generic products.

It is recommended that you involve the Customer Delivery Team in the implementation of exotic product payoffs via pricing scripts.

[NOTE: Only Calypso approved pricing scripts are supported]

Table of Contents

1. Pricing Script

Option Pricing Scripts

"Option" related pricing scripts must be defined in the domain “PricingScript.OPTIONS” by script name. This allows proper option accounting.

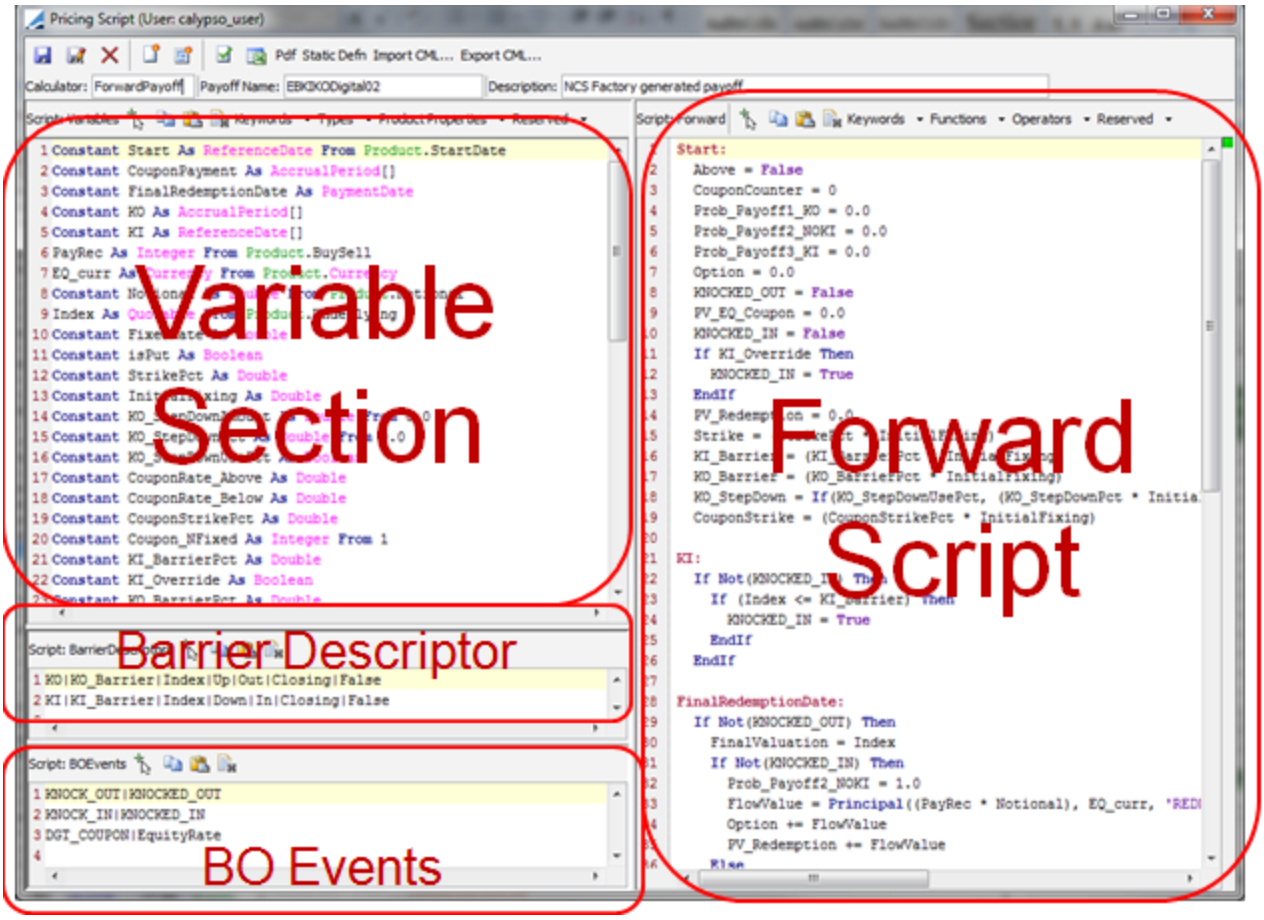
FX TARF Pricing Scripts

FX TARF pricing scripts must be defined in the domain “PricingScript.TARF” by script name. This allows proper FX TARF accounting.

Also, the STRIKE variable must be mapped to the variable defined in the pricing script using the window “Mapping for Pricing Script Report” (menu action `refdata.MappingPricingScriptReportWindow`).

1.1 Pricing Script Overview

Choose **Calypso Navigator > Configuration > System > Add Pricing Script Definition** (menu action `product.cfcalc.PricingScriptDefinitionWindow`) to open the Pricing Script Definition window.



Pricing Script Definition window

The Pricing Script Definition window contains two main script sections. The left panel is the variables section, where all variables and events are defined, and the right side is the forward script.

You can choose **Script: Variables > Declaration** to define the variables or **Script: Variables > Meta Data** to view the variables in table format and set meta data as needed.

Script: Variables | Swap

Name	Type	Display ...	Format	Decimals	Default ...
Barrier_1	*Double*	Barrier_1	DEFAULT	2	60
Barrier_1_Sc...	*PaymentDate...*	Barrier_1_Sc...	DEFAULT	2	
Barrier_1_Type	*Enum*	Barrier_1_Type	DEFAULT	2	
Barrier_2	*Double*	Barrier_2	DEFAULT	2	70
Barrier_2_Sc...	*PaymentDate...*	Barrier_2_Sc...	DEFAULT	2	
Barrier_2_Type	*Enum*	Barrier_2_Type	DEFAULT	2	DI
Barrier_Und	*Double*	Barrier_Und	DEFAULT	2	
Barrier_Und_...	*PaymentDate...*	Barrier_Und_...	DEFAULT	2	
Barrier_Und_...	*Enum*	Barrier_Und_...	DEFAULT	2	DO
BuySell	*Integer*	BuySell	DEFAULT	2	1
CCYQuotable	*Quotable*	CCYQuotable	DEFAULT	2	

1.1.1 Starting Points

Defining a payoff script is essentially writing the pricer. There are two main goals:

- Program the product's cashflows
- Return an NPV to the product

1.1.2 Basic Script Example

The pricing script is an event based forward script. This means, there is defining of the events of the payoff (coupons, fixings, redemptions, etc.) and the corresponding actions as blocks of code. These are then executed in the order in which they are specified.

A vanilla call option can be captured as one event "Payment" where the amount Max(Spot-Strike,0) is paid out. The function call Cash() does two things:

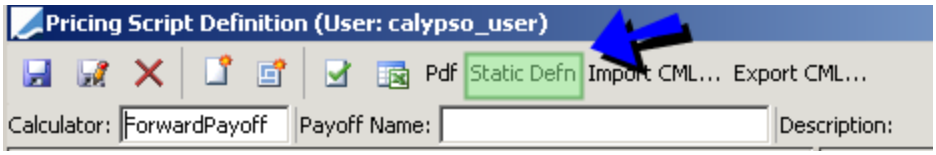
- Generates the cashflows
- Defines NPV by returning the forward value of the payment

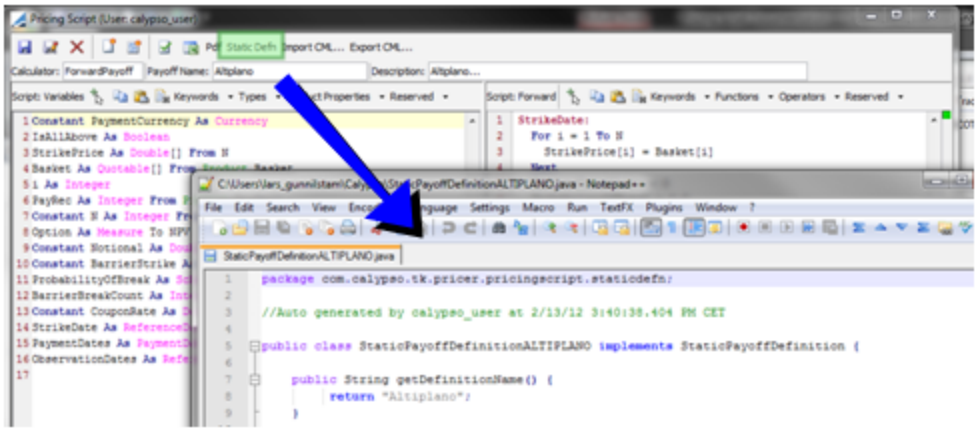
Script: Forward | Keywords | Functions | Operators | Reserved

```
1  Payment:
2    Option = Cash(Max((S - K), 0), curr)
3
```

1.1.3 Static Definition

A payoff can also be exported as java code for jar packaging by clicking "Static Definition".


Pricing Script Definition (User: calypso_user)
Pdf
Static Defn
Import CML...
Export CML...
Calculator:
ForwardPayoff
Payoff Name:
Description:



1.2 Setup

1.2.1 System Lock

In order to save pricing script definitions, the following user environment flags have to be set.

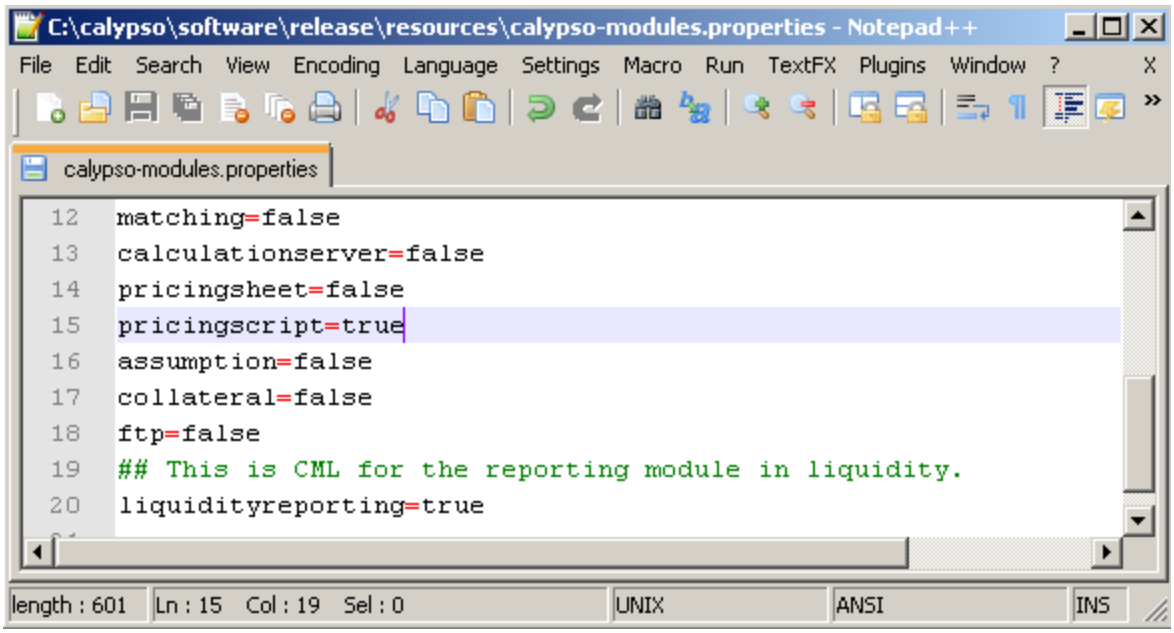
ALLOW_SAVE_PRICING_SCRIPT_VARIABLES_TABLE=true

1.2.2 Calypso ML Activation

In order to use Calypso ML import/export, the file "calypso-module.properties" needs to contain "pricingscript=true".

The file is found under `<calypso_home>/resources/`.

[NOTE: Changes to resources have to be re-deployed to your application servers. Please refer to the Calypso Installation Guide for details]



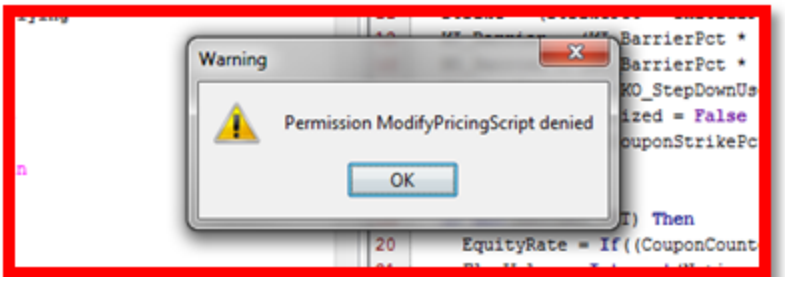
1.2.3 Access Permissions

Access permissions for creating, modifying and removing scripts can be configured in the Access Permissions window, panel "Group Access".

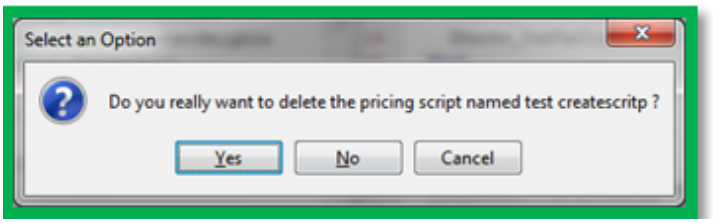
The following functions apply to the Pricing Script Definition window. If they are not available for selection, you can add them to the *function* domain.

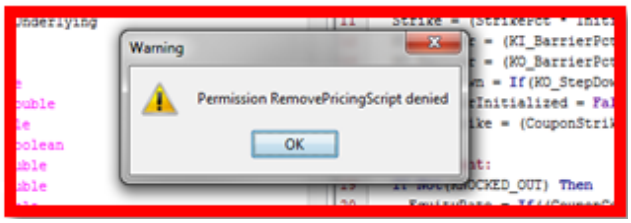
CreatePricingScript

ModifyPricingScript



RemovePricingScript


Select an Option
Do you really want to delete the pricing script named test createscritp ?
Yes
No
Cancel


Warning
Permission RemovePricingScript denied
OK

1.3 Execution process

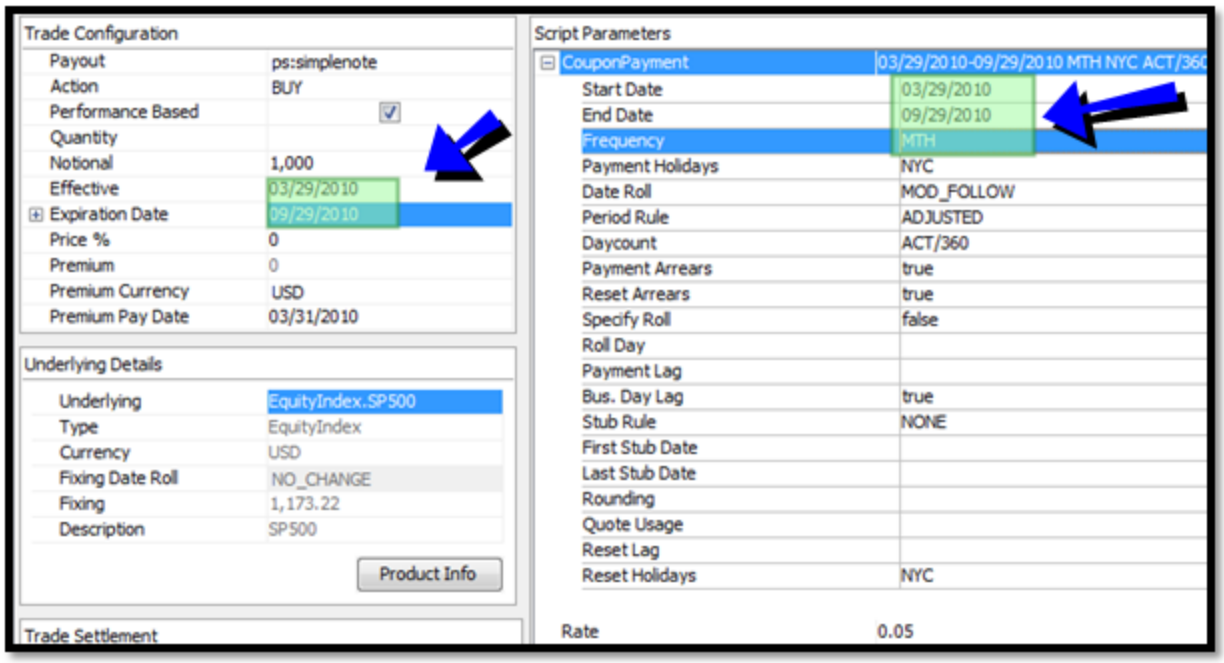
1.3.1 Introduction

To be able to write the scripts, it is crucial to understand the execution process. The following determines the execution process.

Order of Code Blocks within the Pricing Script

```
1  Start:
2    NetValue = 0
3    InitialFixing = Index
4
5  CouponPayment:
6    NetValue += Interest(Notional, Rate, Curr)
7
8  Maturity:
9    NetValue += Principal(((Notional * Index) / InitialFixing), Curr)
```

Trade Setup: The dates assigned by trade to schedules



When the trade is configured, the event grid visualizes the execution pattern, and the user can verify this against the term sheet.

Date	Events
03/29/2010	[Start, CouponPayment]
04/29/2010	[CouponPayment]
05/28/2010	[CouponPayment]
06/29/2010	[CouponPayment]
07/29/2010	[CouponPayment]
08/30/2010	[CouponPayment]
09/29/2010	[Maturity]

The cashflows are then generated based on the execution sequence and the event code.

Pmt End	Pmt Dt	Pmt Amt	Rate	Reset
04/29/2010	04/29/2010	4.31	5.00000	
05/28/2010	05/28/2010	4.03	5.00000	
06/29/2010	06/29/2010	4.44	5.00000	
07/29/2010	07/29/2010	4.17	5.00000	
08/30/2010	08/30/2010	4.44	5.00000	
09/29/2010	09/29/2010	4.17	5.00000	
09/29/2010	09/29/2010	975.72		09/29/2010

1.3.2 Code Example trade ShortPath

The ShortPath payoff definition is an example of a payoff with four schedules.

The code is divided into blocks, with one event per schedule. The code will be executed once per event date. The union of all events constitutes the event dates.

For each event date, the code is executed from top to bottom, and only the events that take place on the current execution date are taken into consideration.

Short Overview:

- Start date – Variables are set to their initial values.
- IR Coupon Date – A floating rate coupon is paid, using the quotable IR_FloatRef. Payments are added to the PriceLegIR measure.
- EQ Coupon Date – An equity linked payment takes place that uses the quotable array Basket. Any payments are added to the PriceLegEQ measure.
- Maturity – Final redemption is calculated and paid out. The final note price is calculated by adding PriceLegEQ + PriceLegIR.

Script: Forward | Keywords | Functions | Operators | Reserved

```
StartDate:
    PriceLegEQ = 0.0

    PriceLegIR = 0.0
    Price = 0.0
    EquityTriggerEvent = False
    counter=0
    EquityTriggerSum = 0.0
    For i=1 To N

        InitialPrice[i]=Basket[i]
        Perf[i]=0.0
    Next

IRCouponDate:
    PriceLegIR += Interest((-1)*Notional,IR_FloatRef,curr)

EQCouponDate:
    counter += 1

    For i=1 To N
        Perf[i]=(Basket[i]-InitialPrice[i])/InitialPrice[i]
    Next

    Rank(Perf, PerfRank)

    TargetBasket=0.0
    For i = 1 To N
        If (PerfRank[i]>(N-NWorstOf)) Then
            TargetBasket+=Perf[i]/NWorstOf
        EndIf
    Next

```

```
34
35
36      If (counter>EQ_NFixedCoupon) Then
37          If (EquityTriggerEvent) Then
38              EQCoupon = EquityTriggerLevel
39          Else
40              EQCoupon = Max(0.0,EQ_MinCoupon+EQ_Participation*TargetBasket)
41          EndIf
42      Else
43         EQCoupon = EQ_FixedCoupon
44      EndIf
45
46      PriceLegEQ += Cash(Notional*EQCoupon,curr)
47      EquityTriggerSum+=EQCoupon
48
49      If  (EquityTriggerSum>EquityTriggerLevel*counter) Then
50          EquityTriggerEvent = True
51      EndIf
52
53  Maturity:
54      If (EquityTriggerEvent) Then
55          PriceLegEQ += Cash(Notional,curr)
56      Else
57          For i=1 To N
58              Perf[i]=(Basket[i])/InitialPrice[i]
59          Next
60          Rank(Perf, PerfRank)
61          TargetBasket=0
62          For i=1 To N
63              If (PerfRank[i]>N-NWorstOf) Then
64                  TargetBasket+=Perf[i]
65              EndIf
66          Next
67          TargetBasketValue =TargetBasket/NWorstOf
68          PriceLegEQ+=Cash(Notional*Max(EQ_Floor,TargetBasketValue),curr)
69      EndIf
70
71      Price = PriceLegIR+PriceLegEQ
72
```

Meta Data

You can choose

1.3.3 Trade Capture

Pricing Script trades are captured using the Pricing Sheet - Please refer to Calypso Pricing Sheet documentation for details.

2. Exotic Settlement Report

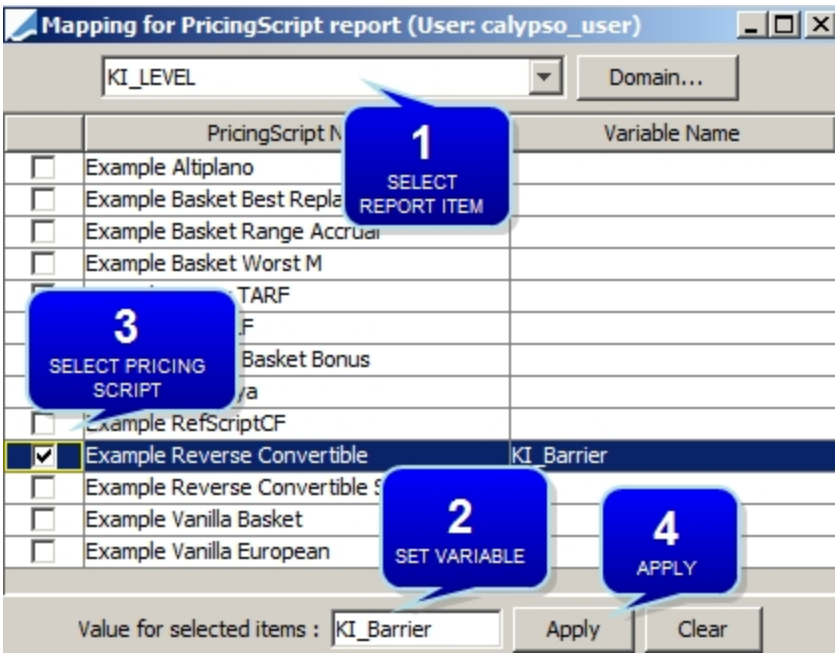
The Exotic Settlement report allows projecting lifecycle events for Pricing Script products (KI, KO, physical delivery, coupon).

2.1 Before You Begin

For many of the features present in the Exotic Settlement report, the Payoff variables need to be mapped to the reporting items. Sample mappings:

Applicable for script features	Report Item	Variable Name
KO	KO_LEVEL	KO_Barrier
KO	KNOCKED_OUT	KNOCKED_OUT
KO	SCHEDULE_KO_VARIABLE	CouponPayment
KI	KI_LEVEL	
KI	KNOCKED_IN	KNOCKED_IN
KI	SCHEDULE_KI_VARIABLE	KI
Basket	WORST_LEVEL_INDEX	Basket
Note	REFERENCE_PRICE	InitialFixing
Note	SCHEDULE_COUPON_PAYMENT_VARIABLE	CouponPayment
Note – Digital	COUPON_STRIKE	CouponStrike
Note – Digital	COUPON_RATE	EquityRate
Note – Fixed	COUPON_RATE	FixedRate

From Calypso Navigator choose **Configuration > System > Add Pricing Script Mapping** (menu action `refdata.MappingPricingScriptReportWindow`) to bring up the Pricing Script Mapping window.



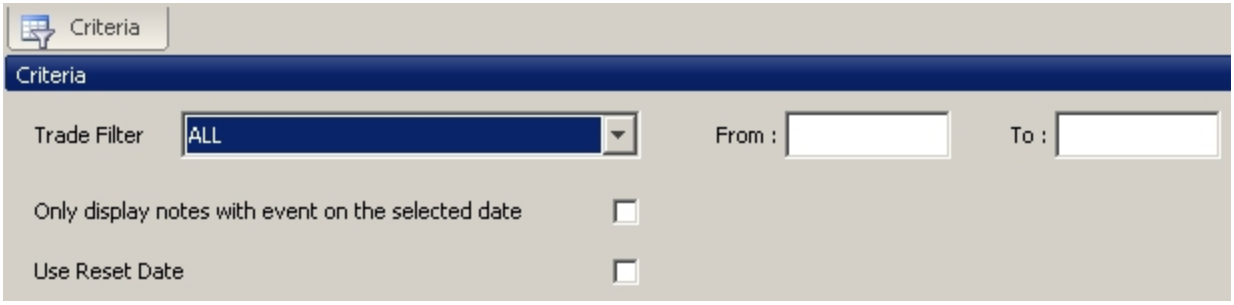
Pricing Script Mapping window

- Select a report item at the top of the window.
- Enter the variable name at the bottom of the window.
- Check the boxes to select the pricing scripts to which the selected mapping applies.
- Click **Apply**.

2.2 Running the Report

From Calypso Navigator choose **Reports > Securities Reports > Exotic Settlement Report** (menu action `reporting.ReportWindow$ExoticSettlement`) to bring up the Exotic Settlement report.

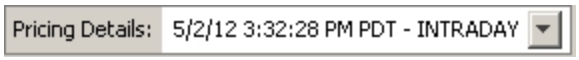
You can select **View > Show Frame > Criteria** to specify search criteria as needed.



Exotic Settlement report - Selection criteria

- Select a specific Trade Filter or choose ALL.
- Use the "From" and "To" fields to limit the results to trade events in a specified time range.

- Tick the "Only display notes with event on the selected date" checkbox to only show the products with events on the valuation date.
- Tick the "Use Reset Date" checkbox to select events by reset date. They are selected by payment date otherwise.
- Specify the pricing environment and valuation date at the bottom of the report window.

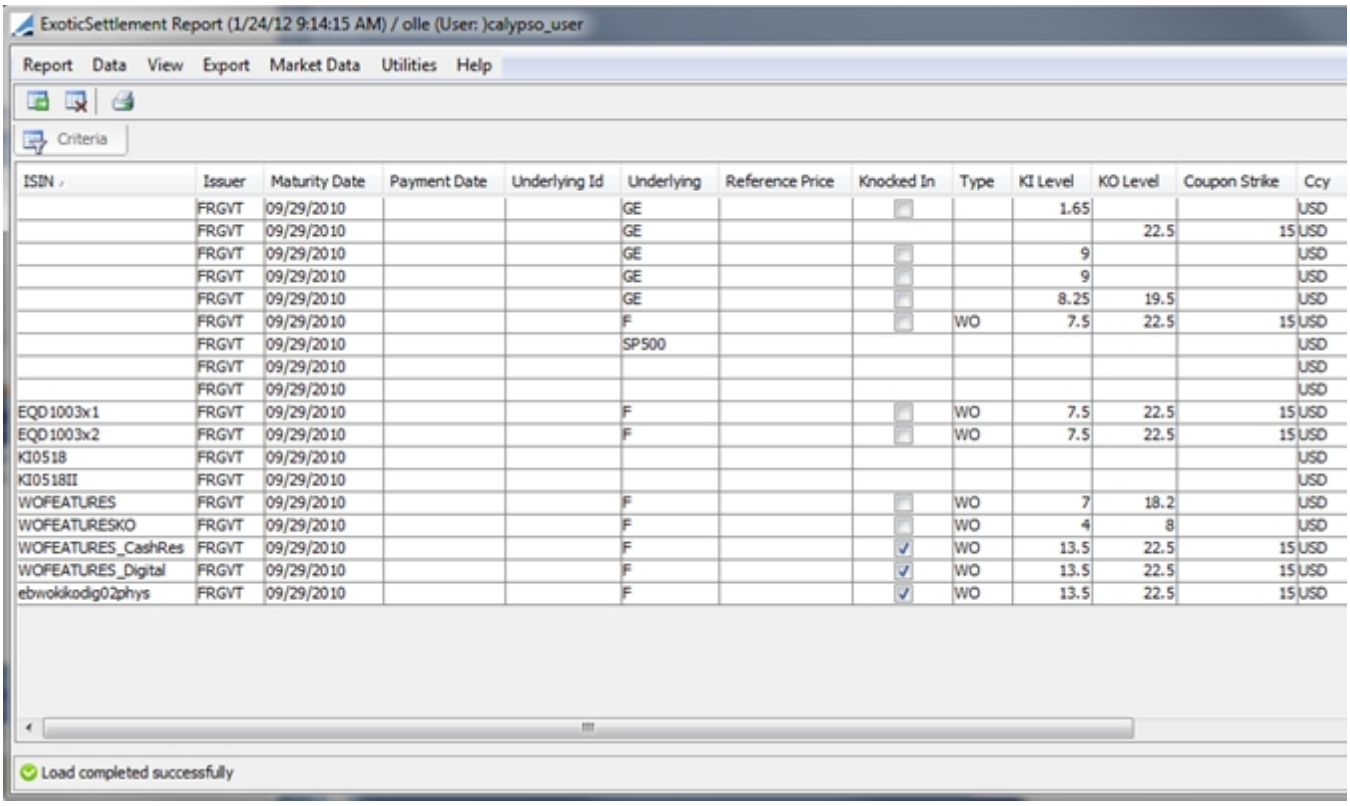


By default, the pricing details are current:

  - The pricing environment defaults to the one set in the User Defaults.
  - The valuation date is the current date and time.

You can click the down arrow to change the default values.

- Click to run the report and view the results.



ISIN	Issuer	Maturity Date	Payment Date	Underlying Id	Underlying	Reference Price	Knocked In	Type	KI Level	KO Level	Coupon Strike	Ccy
	FRGVT	09/29/2010			GE				1.65			USD
	FRGVT	09/29/2010			GE					22.5	15	USD
	FRGVT	09/29/2010			GE				9			USD
	FRGVT	09/29/2010			GE				9			USD
	FRGVT	09/29/2010			GE				8.25	19.5		USD
	FRGVT	09/29/2010			F			WO	7.5	22.5	15	USD
	FRGVT	09/29/2010			SP500							USD
	FRGVT	09/29/2010										USD
	FRGVT	09/29/2010										USD
EQD1003x1	FRGVT	09/29/2010			F			WO	7.5	22.5	15	USD
EQD1003x2	FRGVT	09/29/2010			F			WO	7.5	22.5	15	USD
KI0518	FRGVT	09/29/2010										USD
KI0518II	FRGVT	09/29/2010										USD
WOFEATURES	FRGVT	09/29/2010			F			WO	7	18.2		USD
WOFEATURESKO	FRGVT	09/29/2010			F			WO	4	8		USD
WOFEATURES_CashRes	FRGVT	09/29/2010			F		✓	WO	13.5	22.5	15	USD
WOFEATURES_Digital	FRGVT	09/29/2010			F		✓	WO	13.5	22.5	15	USD
ebwokikodig02phys	FRGVT	09/29/2010			F		✓	WO	13.5	22.5	15	USD

Exotic Settlement report - Sample results

- You can click to print the report results.

Exotic Settlement Report Results

Click any column heading to sort the results based on that column.

Right-click any column heading to modify the report configuration. Included in the Configure Columns selection list, among an assortment of options, is a folder containing Security Codes, as shown below.