

# Sky Converter User Manual

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## Sky Converter User Manual

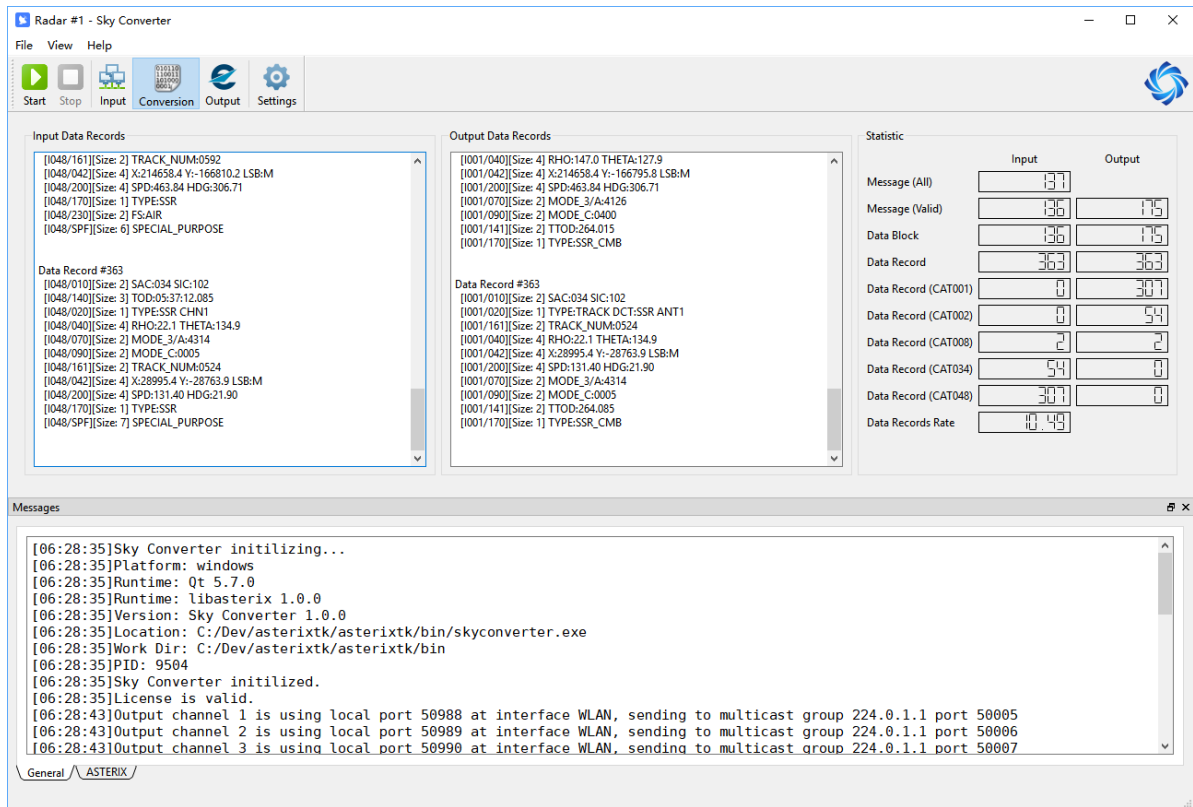
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## Overview

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### Introduction

**Sky Converter** is a Mode-S & Mode-A/C radar format converter.



Sky Converter receives plots and/or tracks from radar, modifies data contents and converts data formats according to predefined rules, and then distributes to downstream users.

Sky Converter is typically used as a radar front end processor, and can be used in scenarios listed below:

- Integrating new Mode-S radar into existing ATM systems which doesn't supports Mode-S formats, by converting data from Mode-S formats into Mode-A/C formats.
- Modifying data fields in original radar data, such as SAC/SIC and timestamp.
- Detect and fix erroneous data fields in original radar data, which are usually caused by problems of radar itself, such as fake TCAS alerts and fake distress SSR code.
- Filter unneeded data from specific source or in specific category for downstream system.

## Applicability

This document is based on Sky Converter version 1.x.

## Copyrights

[Sky Converter](#) is a product of [SinoATC](#), please contact [info@sinoatc.com](mailto:info@sinoatc.com) for more information.

## Getting Started

### Concepts

Sky Converter in general has three modules: receiver, processor and transmitter.

Receiver receives input data from upstream system, such as PSR, SSR or ASR.

Processor modifies and/or converts radar data according to predefined rules.

Transmitter sends output data to downstream systems.

## Receiver

Receiver works with LAN interfaces and uses UDP multicast protocol.

It receives message from LAN and send it to processor for further processing.

User can specify hardware interface, multicast address and UDP port in configuration.

Legacy interface like RS232/HDLC can also be supported by using Serial-LAN adaptor.

## Processor

Processor is the core module of Sky Converter, it decodes, modifies and converts data packets received from Receiver, and send generated data packets to transmitter.

Processor consists of three components: dispatcher, modifier, and converter.

### Dispatcher

When a message is received from LAN, receiver will remove all headers used by low level protocols, and send message payload (we call it data packet) to dispatcher.

Dispatcher will try to decode and extract ASTERIX data block from data packet.

For each extracted ASTERIX data block, three actions would be applied according to configuraiton.

- Process  
Data block will be send to Modifier for further processing.
- Bypass  
Data block will be sent to Transmitter for output, no any modification will be applied on data block.
- Discard  
Data block will be dropped, no further action will be made.

Different action can be applied per each ASTERIX category, so this function can also be used to filter out unneeded categories for downstream system.

### Modifier

Data block eligible for "process" will be decoded to a series of data records. Each data record will be sent to Modifier for further processing.

Modifier is like a pipeline, it has a series of sub-modifiers, data record will be sent to each sub-modifier and processed one by one.

Each sub-modifier has specific function, and will modify (or not modify) data record according to predefined configuration. The output of first sub-modifier is the input of the second sub-modifier.

Once a data record has passed all sub-modifiers, it will get out of pipeline, and be sent to converter.

Modifier works on data record, it may modify content of data data record but it will not change category of data record.

In current version of Sky Converter, following sub-modifiers has been implemented.

- SAC/SIC modifier  
Change SAC/SIC value in data record to a new one.

This can be used to fix incorrect SAC/SIC in original radar without having to change settings in radar.

It is also useful when integrating both original data and modified data into a same downstream system.

- Timestamp modifier

Change timestamp in data record to current UTC time.

This is useful when injecting recorded data into a system for processing.

- Fake distress squawk suppression

Detect fake distress squawk in data stream and change it back to normal code or mark it to garbled.

This is used to detect and suppress fake distress squawk from some Selex radars, which can cause unnecessary fake hijack, communication fail and emergency alerts in ATM system.

## **Converter**

Converter receives data record from modifier, convert it to another category, and send it to transmitter.

For each ASTERIX category, different conversion actions can be selected, by in general there are two actions.

- Passthrough

Data recorder will not be converted and will passthrough converter untouched.

- Convert

Data recorder will be converted to another category.

## **Transmitter**

Transmitter works with LAN interfaces and uses UDP multicast protocol.

It obtains ASTERIX data records from processor, assembles them into ASTERIX data block, and sends data block to LAN.

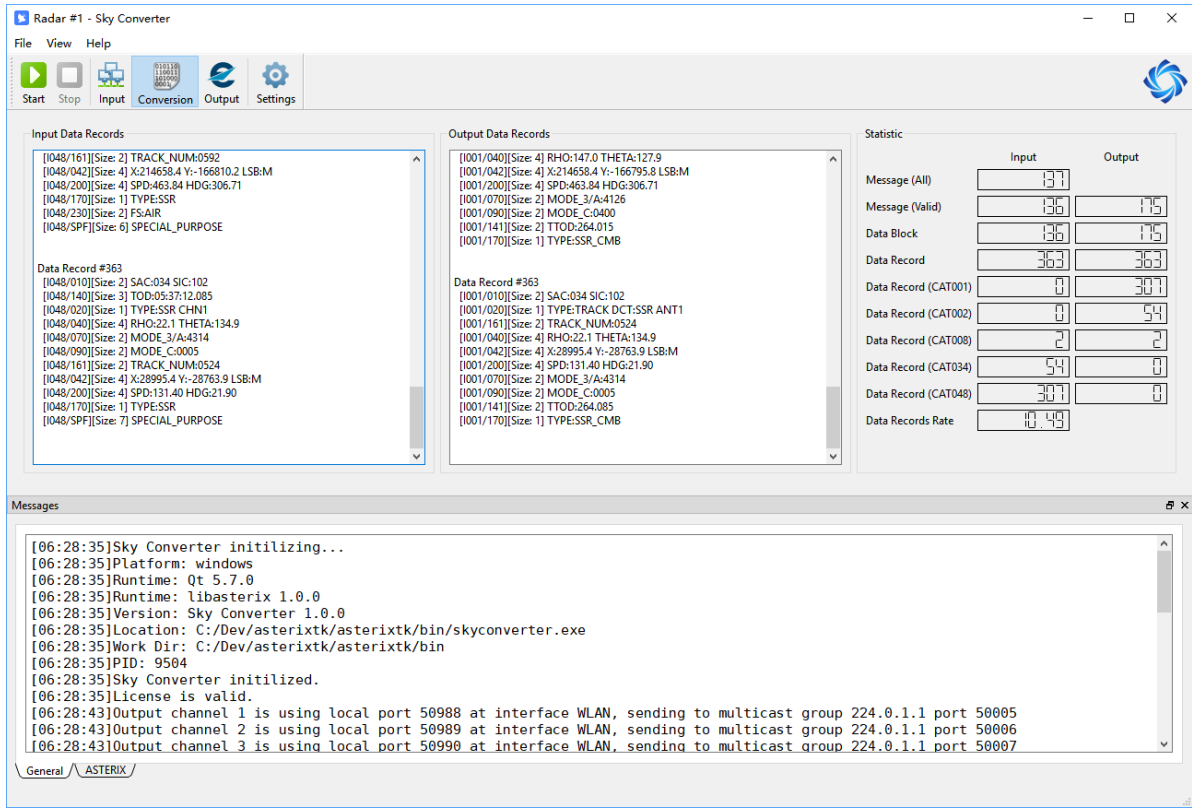
Transmitter can send one ASTERIX data block to up to ten (10) destinations.

User can specify hardware interface, multicast address and UDP port in configuration.

Legacy interface like RS232/HDLC can be also supported by using LAN-Serial adaptor.

## **Main window**

The main window of Sky Converter is shown as below.



As a GUI application, it composes of a main menu at top, a tool bar with different buttons below the main menu, a status bar on bottom, and switchable views in the center.

## Main Toolbar

The main toolbar functions can be put into several groups.



Tool Button	Function Group	Description
Start	Process Control	Start processing.
Stop	Process Control	Stop processing.
Input	View Switch	Switch to input message view, original messages received is shown in this view.
Conversion	View Switch	Switch to conversion view, data records sending to pipeline and out of pipeline will be shown in this view.
Output	View Switch	Switch to output message view, processed messages will be displayed in this view.

# Views

In the center of main window, it displays switchable view. There are three views.

## Input View

**Sky Converter**

File View Help

Start Stop Input Conversion Output Settings

SEQUENCE	TIME STAMP	CATEGORY	BYTES
48	2019-07-19 22:38:44	CAT008	11 08000BC1402266FE380000
49	2019-07-19 22:38:44	CAT048	346 30015AFDFF030422662895FDA06594D3D10E760;
50	2019-07-19 22:38:44	CAT048	318 30013EFDF0304226628960AA06C66DA87048E0;
51	2019-07-19 22:38:44	CAT034	11 22000BF02266022895F5D0
52	2019-07-19 22:38:44	CAT---	106 08006AE108226604A818F7EFF8EFFE7FFF7FEF8FF
53	2019-07-19 22:38:44	CAT034	11 22000BF0226602289614E0
54	2019-07-19 22:38:44	CAT048	226 3000E2FDF03042266289614A08BE8E031044F03;
55	2019-07-19 22:38:44	CAT008	10 08000AC1102266FF0018
56	2019-07-19 22:38:44	CAT034	11 22000BF0226602289633F0
57	2019-07-19 22:38:44	CAT048	235 3000EBDF03042266289637A00D3DF1E9005A0;
58	2019-07-19 22:38:44	CAT048	314 30013AFDFF03042266289658A06C1902340510B;
59	2019-07-19 22:38:44	CAT048	307 300133FDF03042266289665E0330208FA007A03;
60	2019-07-19 22:38:45	CAT034	11 22000BF022660228965400

0000 22 00 0b f0 22 66 02 28 96 54 00 "..."E.(.T.

Data Block: 1  
Data Record: 1  
[034/010][Size: 2] SAC:034 SIC:102  
[034/000][Size: 1] MSG\_TYPE:SECTOR\_CROSSING  
[034/030][Size: 3] TOD:05:46:20.656  
[034/020][Size: 1] SECTOR:000DEG

Messages

```
[06:28:35]Sky Converter intilizing...
[06:28:35]Platform: windows
[06:28:35]Runtime: Qt 5.7.0
[06:28:35]Runtime: libasterix 1.0.0
[06:28:35]Version: Sky Converter 1.0.0
[06:28:35]Location: C:/Dev/asterixtk/asterixtk/bin/skyconverter.exe
[06:28:35]Work Dir: C:/Dev/asterixtk/asterixtk/bin
[06:28:35]PID: 9504
[06:28:35]Sky Converter intilized.
[06:28:35]License is valid.
[06:28:43]Output channel 1 is using local port 50988 at interface WLAN, sending to multicast group 224.0.1.1 port 50005
[06:28:43]Output channel 2 is using local port 50989 at interface WLAN, sending to multicast group 224.0.1.1 port 50006
[06:28:43]Output channel 3 is using local port 50990 at interface WLAN, sending to multicast group 224.0.1.1 port 50007
```

General / ASTERIX /

UDP output has stopped.

All messages received from LAN will be shown here, if received message contains ASTERIX data and can be correctly decoded, the decoded message will also be shown in this view.

## Conversion View

**Radar #1 - Sky Converter**

File View Help

Start Stop Input Conversion Output Settings

Input Data Records

```
[048/161][Size: 2] TRACK_NUM:0592
[048/042][Size: 4] X:214658.4 Y:-166810.2 LSB:M
[048/200][Size: 4] SPD:463.84 HDG:306.71
[048/170][Size: 1] TYPE:SSR
[048/230][Size: 2] FS:ARR
[048/SPF][Size: 6] SPECIAL_PURPOSE
```

Data Record #363

```
[048/010][Size: 2] SAC:034 SIC:102
[048/140][Size: 2] TOD:05:37:12.085
[048/020][Size: 1] TYPE:SSR CHN1
[048/040][Size: 4] RHO:22.1 THETA:134.9
[048/070][Size: 2] MODE_3/A:4314
[048/090][Size: 2] MODE_C:0005
[048/161][Size: 2] TRACK_NUM:0524
[048/042][Size: 4] X:28995.4 Y:-28763.9 LSB:M
[048/200][Size: 4] SPD:131.40 HDG:21.90
[048/170][Size: 1] TYPE:SSR
[048/SPF][Size: 7] SPECIAL_PURPOSE
```

Output Data Records

```
[001/040][Size: 4] RHO:147.0 THETA:127.9
[001/042][Size: 4] X:214658.4 Y:-166795.8 LSB:M
[001/200][Size: 4] SPD:463.84 HDG:306.71
[001/070][Size: 2] MODE_3/A:4126
[001/090][Size: 2] MODE_C:0400
[001/141][Size: 2] TOD:264.015
[001/170][Size: 1] TYPE:SSR_CMB
```

Data Record #363

```
[001/010][Size: 2] SAC:034 SIC:102
[001/020][Size: 1] TYPE:TRACK DCT:SSR ANT1
[001/161][Size: 2] TRACK_NUM:0524
[001/040][Size: 4] RHO:22.1 THETA:134.9
[001/042][Size: 4] X:28995.4 Y:-28763.9 LSB:M
[001/200][Size: 4] SPD:131.40 HDG:21.90
[001/070][Size: 2] MODE_3/A:4314
[001/090][Size: 2] MODE_C:0005
[001/141][Size: 2] TOD:264.085
[001/170][Size: 1] TYPE:SSR_CMB
```

Statistic	Input		Output	
	Value	Count	Value	Count
Message (All)	137	137	175	175
Message (Valid)	136	136	175	175
Data Block	136	136	175	175
Data Record	363	363	363	363
Data Record (CAT001)	0	0	307	307
Data Record (CAT002)	0	0	54	54
Data Record (CAT008)	2	2	2	2
Data Record (CAT034)	54	54	0	0
Data Record (CAT048)	307	307	0	0
Data Records Rate	10.49	10.49		

Messages

```
[06:28:35]Sky Converter intilizing...
[06:28:35]Platform: windows
[06:28:35]Runtime: Qt 5.7.0
[06:28:35]Runtime: libasterix 1.0.0
[06:28:35]Version: Sky Converter 1.0.0
[06:28:35]Location: C:/Dev/asterixtk/asterixtk/bin/skyconverter.exe
[06:28:35]Work Dir: C:/Dev/asterixtk/asterixtk/bin
[06:28:35]PID: 9504
[06:28:35]Sky Converter intilized.
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[06:28:43]Output channel 1 is using local port 50988 at interface WLAN, sending to multicast group 224.0.1.1 port 50005
[06:28:43]Output channel 2 is using local port 50989 at interface WLAN, sending to multicast group 224.0.1.1 port 50006
[06:28:43]Output channel 3 is using local port 50990 at interface WLAN, sending to multicast group 224.0.1.1 port 50007
```

General / ASTERIX /

All data records eligible for processing will be shown in this view.

On the left it shows original data records before entering processor.

In the middle it shows processed data records output from processor.

Statistical information is displayed on the right.

## Output View

The screenshot displays the Sky Converter application window. The interface is divided into several sections:

- Top Bar:** Contains menu options (File, View, Help) and control buttons (Start, Stop, Input, Conversion, Output, Settings).
- Main Data Table:** A table with columns: SEQUENCE, TIME STAMP, CATEGORY, and BYTES. It lists 13 data records (sequences 63-75).
- Hex Data View:** Shows two lines of hexadecimal data: 0000 01 00 1d ff c4 20 20 a0 02 10 4a 0b 0e 48 0c b3 and 0010 22 b8 08 4f 1f a5 00 70 05 a0 3a 82 40. To the right, there is a text representation of the data: "...J..H.." and "...p...:..@".
- Data Block:** A section titled "Data Block" containing a "Data Record: 1" with various parameters such as SAC:032, TRACK\_NUM:0528, RHO:148.1, and TMODE: C-0360.
- Messages Window:** A scrollable log at the bottom showing system messages, including initialization status, platform (windows), runtime (Qt 5.7.0), version (Sky Converter 1.0.0), location, work directory, PID (9504), and license validation. It also shows output channel configurations for LAN ports 50988, 50989, and 50990.

Assembled data blocks and data packets are shown in output view, they will be sent to LAN to external systems.

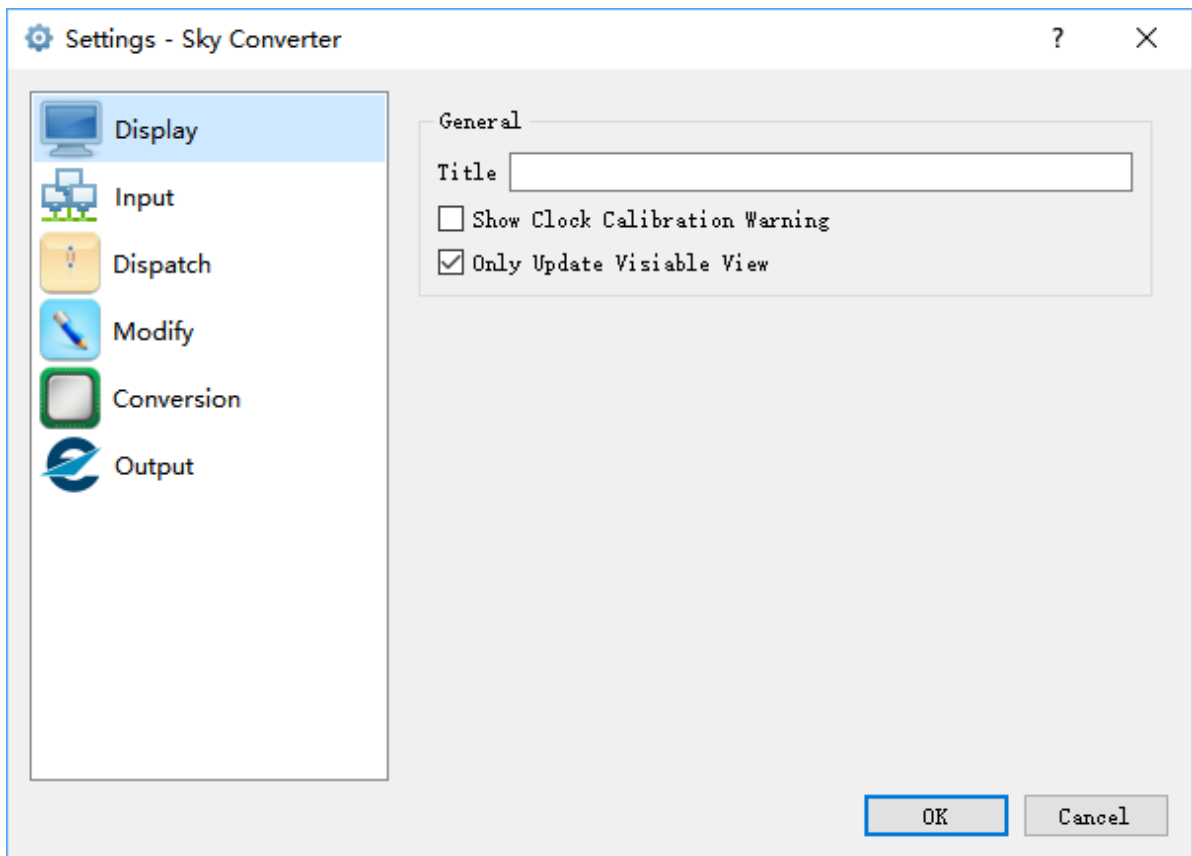
## Messages

At the bottom of main window, there is a message window showing systems messages.

This window can be closed.

## Configuration

## Display



## Title

A free text can be filled in this field, it will be displayed in the title bar of main window, and also in OS desktop components (e.g. Windows taskbar). It helps user to distinguish when multiple instances are running.

## Show Clock Calibration Warning

When selected, a warning message will be shown before stat processing.

Some system functions relies on host computer system clock, it is used as a reminder.

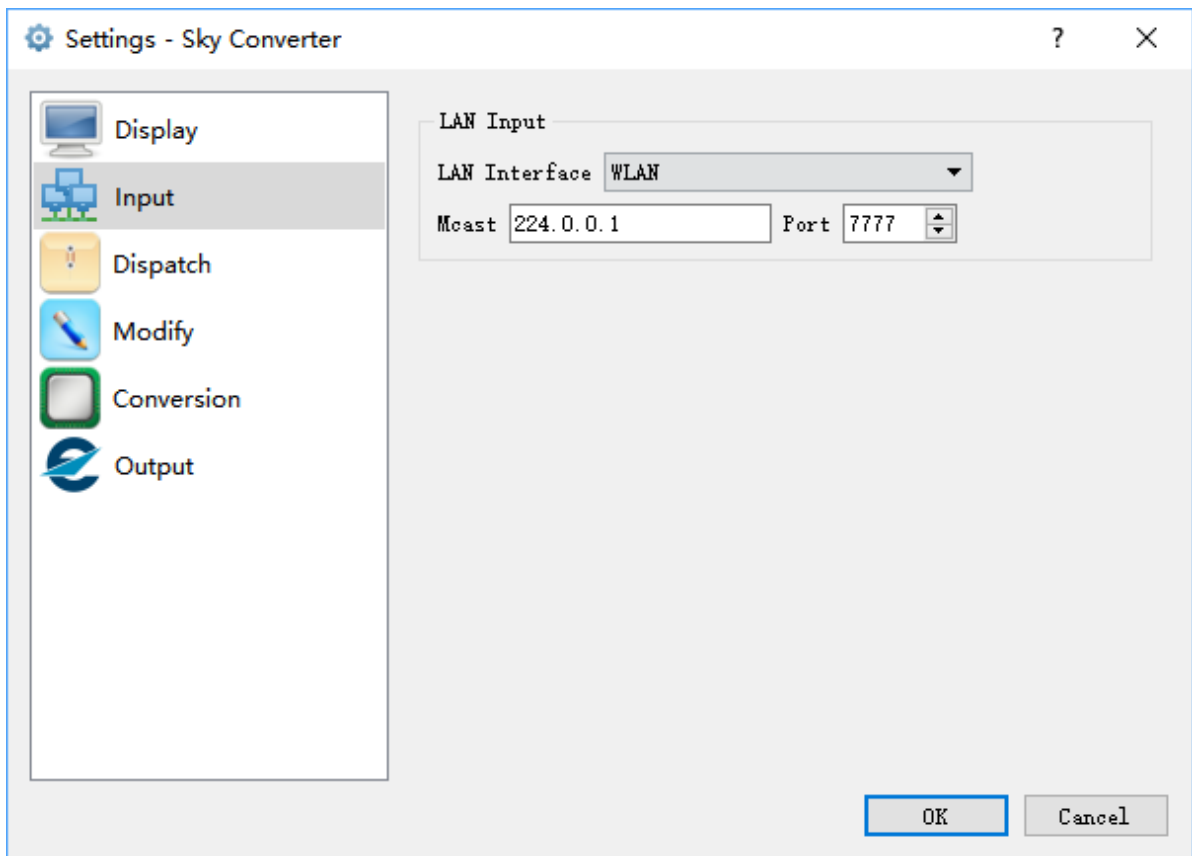
## Only Update Visible View

When selected, only the UI of current visible view will be updated.

This is used to reduce system load.

## Input





### **LAN Interface**

Physical LAN interface which will be used to receive messages.

The interfaces are reported by OS and only active interfaces supporting multicast are listed here.

### **Mcast**

Multicast address of input messages.

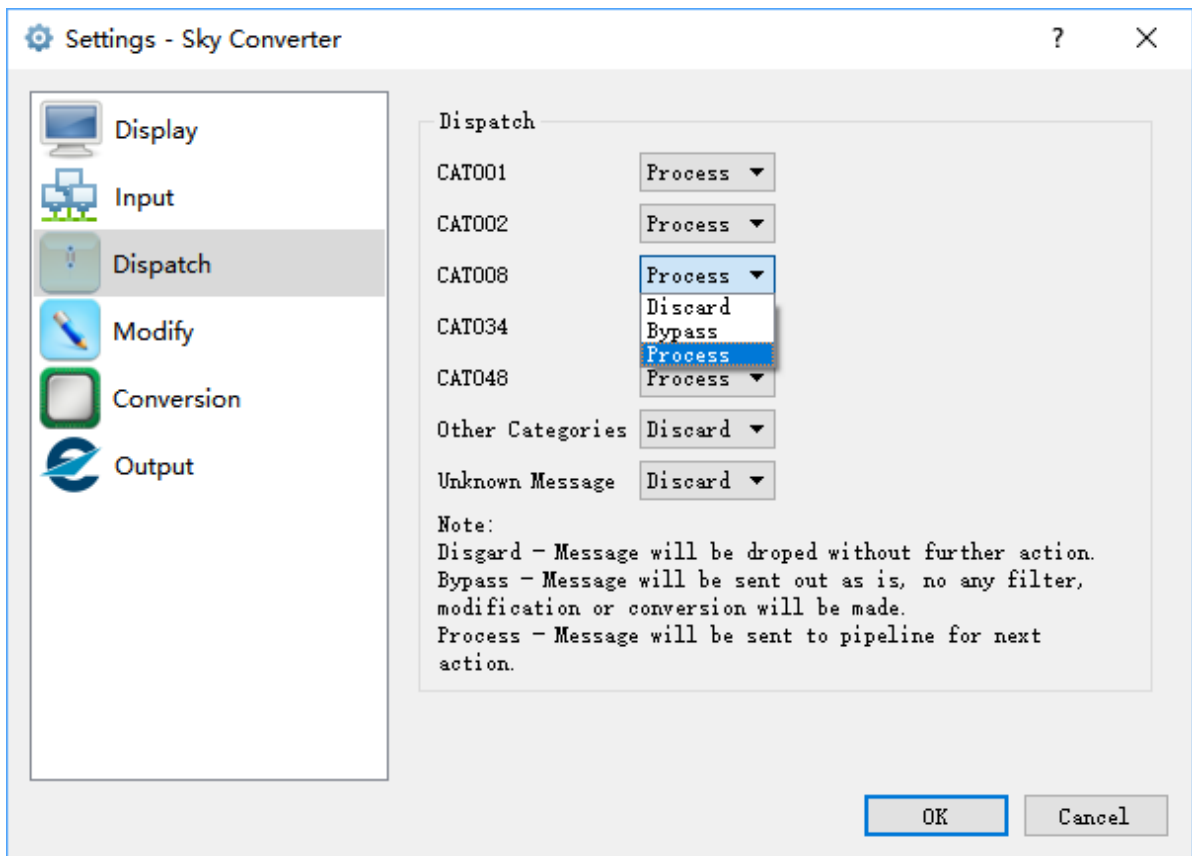
System will join this group after starting process.

### **Port**

UDP port of input messages.

System will listen on this port after starting process.

## **Dispatch**



## Dispatch

Dispatch actions for each category of data block.

Three actions can be selected for each category.

- Process  
Data block will be send to Modifier for further processing.
- Bypass  
Data block will be sent to Transmitter for output, no any modification will be applied on data block.
- Discard  
Data block will be dropped, no further action will be made.

Categories not listed will apply to action specified in "Other Categories".

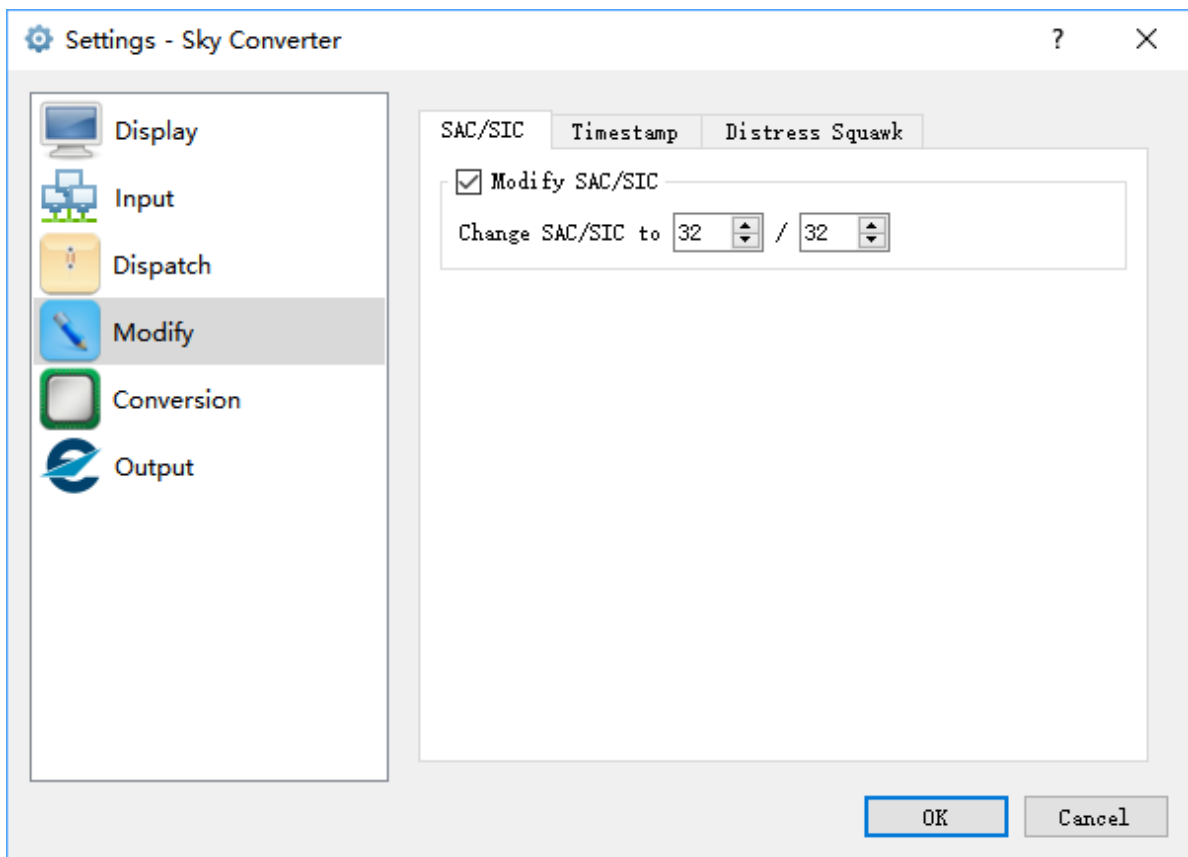
Undecodable message will apply to action specified in "Unknown Message" and always be dropped.

## Modifier

Modify settings include several pages, one per each sub-modifier.

- SAC/SIC Modifier
- Timestamp Modifier
- Fake Distress Squawk Supression

## SAC/SIC Modifier



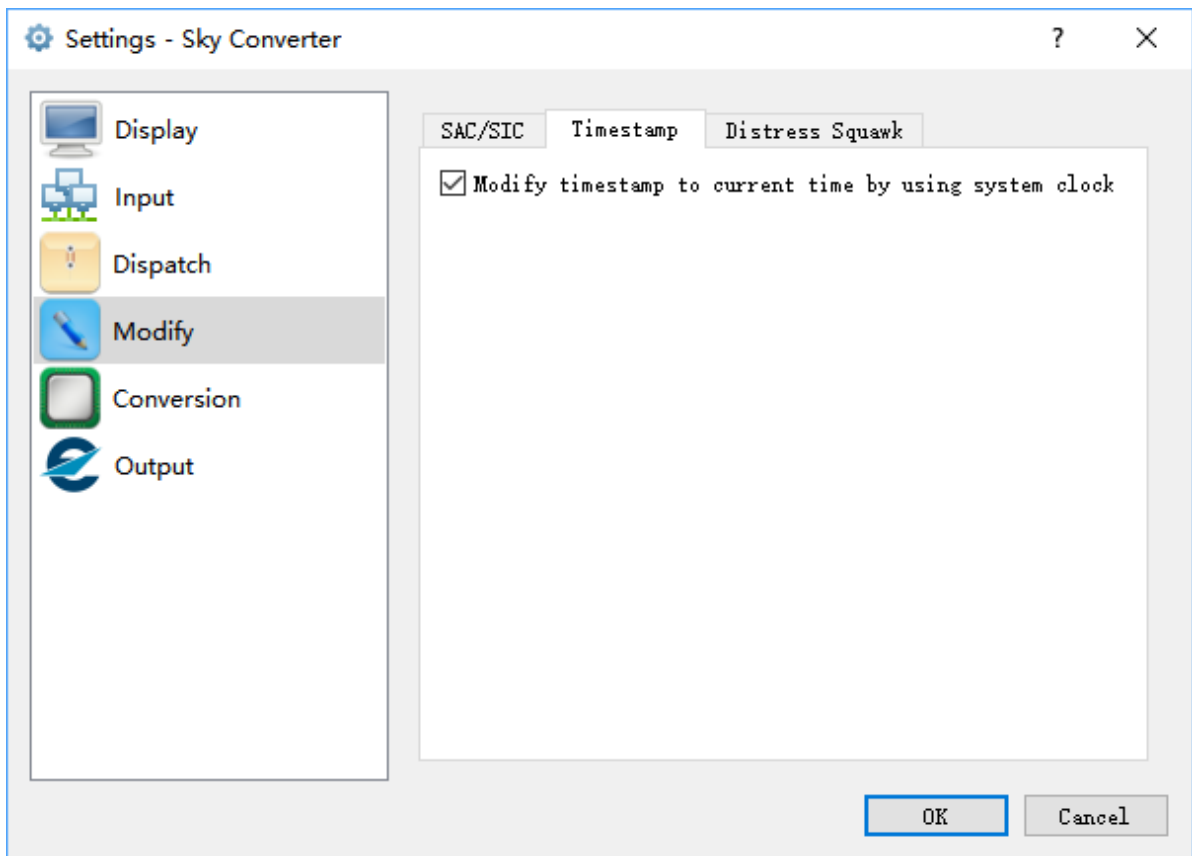
### Modify SAC/SIC

This sub-modifier will be enabled when selected.

### Change SAC/SIC to ????

New SAC and SIC that will be used.

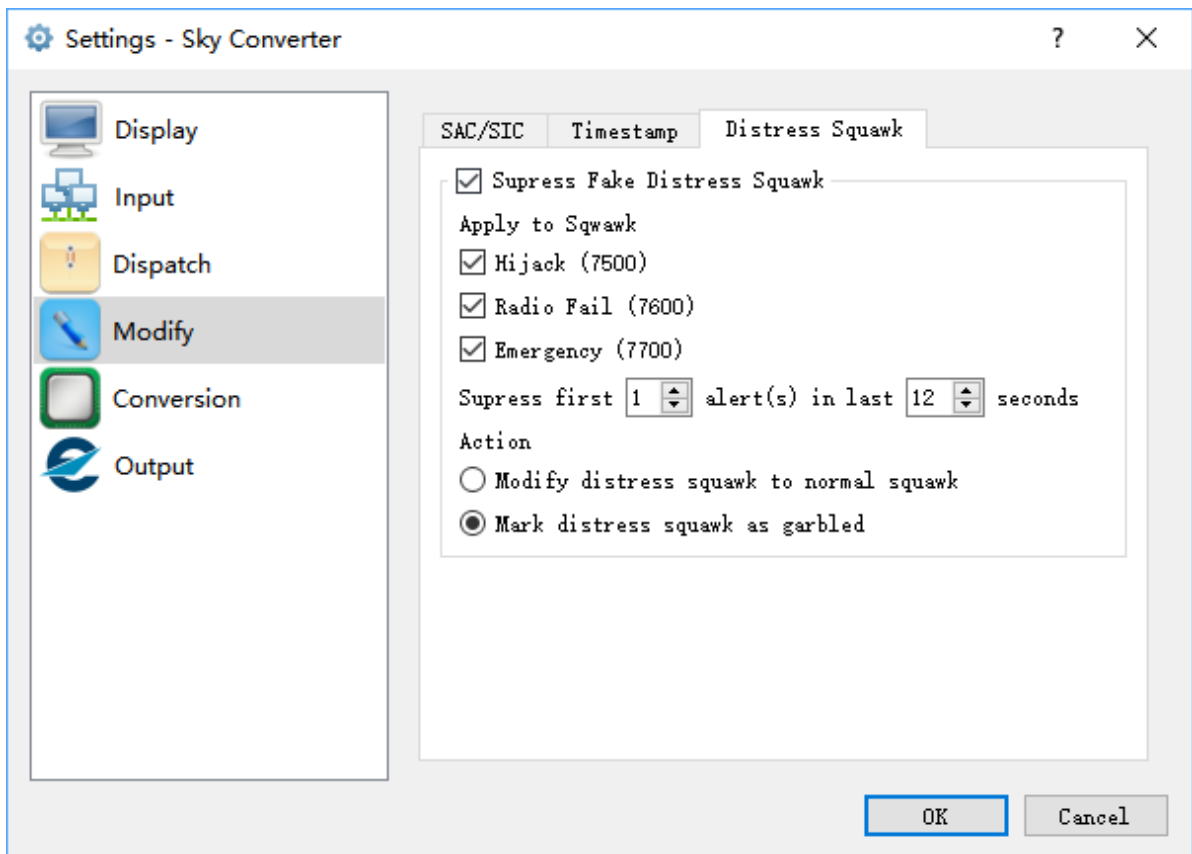
### Timestamp Modifier



### Modify timestamp to current time by using system clock

This sub-modifier will be enabled when selected.

### Fake Distress Squawk Suppression



### Suppress Fake Distress Squawk\*\*

This sub-modifier will be enabled when selected.

## Apply to Squawk

Only selected squawk will be detected and suppressed, including

- 7500 Hijack
- 7600 Radio Fail
- 7700 Emergency

## Suppress first ? alerts in last ? seconds

System will apply suppression action to first data records in a period, this is used to avoid suppressing real distress squawk.

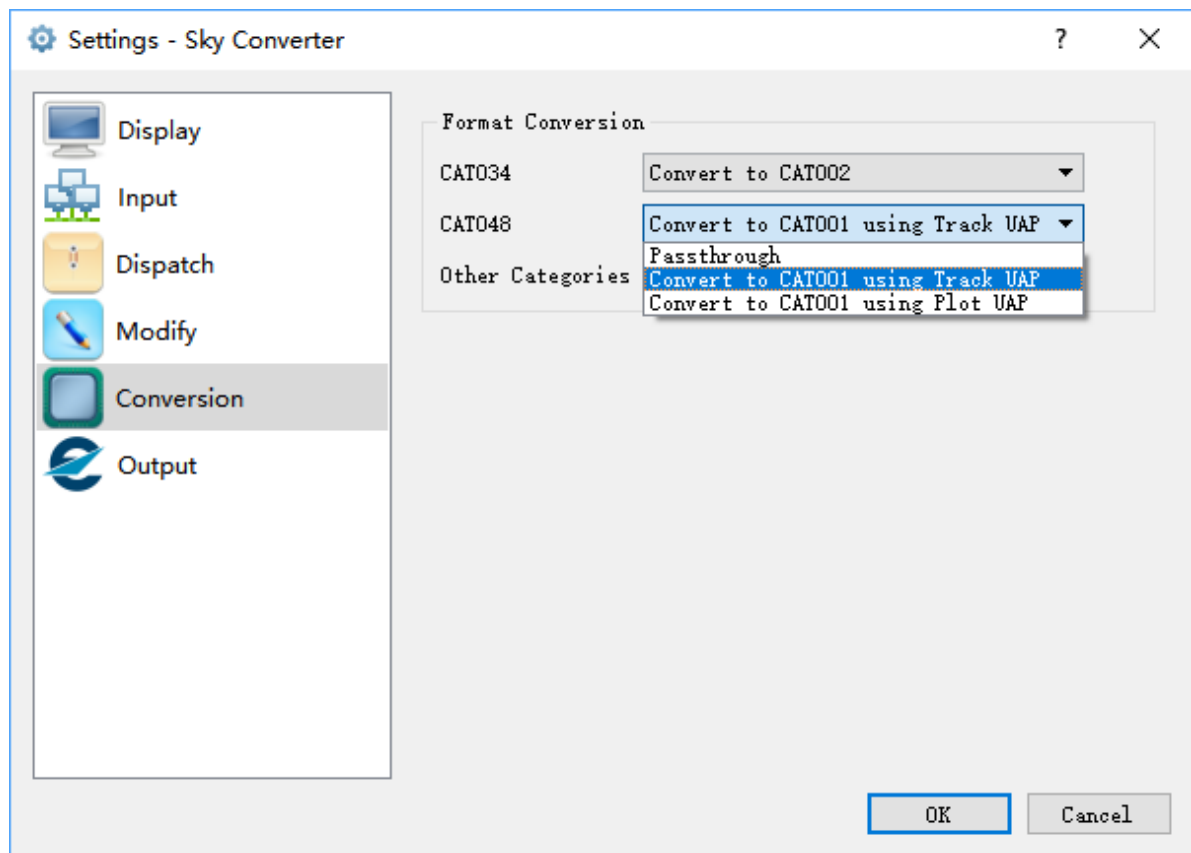
Typical setting is to suppress first 1 alert in 3 radar rotations (12 seconds or 15 seconds).

## Action

Suppression actions.

- Modify distress squawk to normal squawk  
Squawk in data record will be modified to the last received non-distress squawk from this track.
- Mark distress squawk as garbled  
Squawk in data record will not be modified but its garble-bit will be set to 1.

## Conversion



## Format Conversion

Data record conversion actions for each category.

### CAT034

- Passthrough

Data recorder will not be converted and will passthrough converter untouched.

- Convert to CAT002

Mode-S radar CAT034 data record will be converted to conventional radar CAT002 data record, standard UAP will apply.

### CAT048

- Passthrough

Data recorder will not be converted and will passthrough converter untouched.

- Convert to CAT001 using Track UAP

Mode-S radar CAT048 data record will be converted to conventional radar CAT001 data record, standard track UAP will apply.

- Convert to CAT001 using Plot UAP

Mode-S radar CAT048 data record will be converted to conventional radar CAT001 data record, standard plot UAP will apply.

### Other Categories

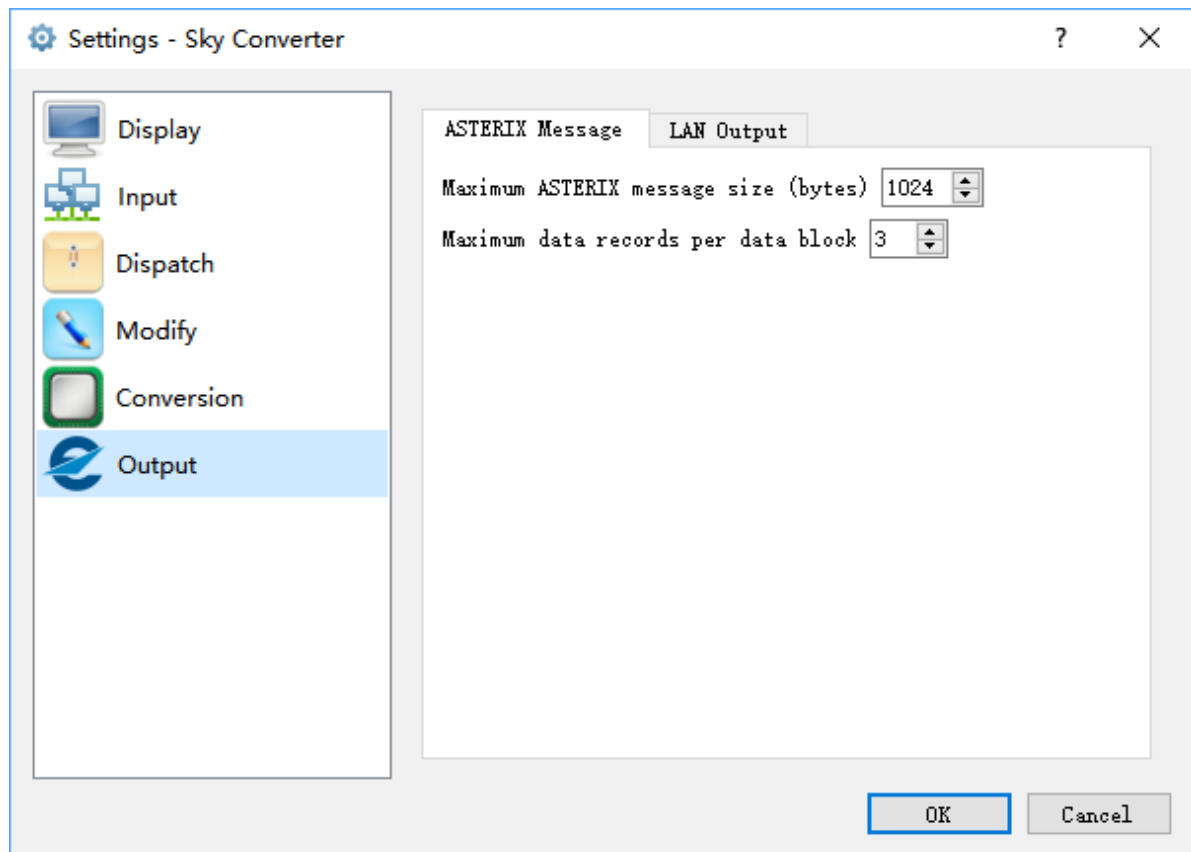
- Passthrough

Data recorder will not be converted and will passthrough converter untouched.

## Output

Output settings include several pages.

### ASTERIX



#### Maximum ASTERIX message size

Maximum size of each data block.

When a new data record is created, if current data block has enough space to hold it, it will be assembled into current data block. If current data block has no enough space, data block will be sent out, and data record will be assembled into a new data block.

### Maximum data records per data block

Maximum number of data records in one data block.

When a new data record is created and assembled into current data block, if number of data records in this data block has reached maximum number specified here, the data block will be immediately sent out.

## LAN

CH	Interface	Mcast Address	Port
<input checked="" type="checkbox"/> 01	WLAN	224.0.1.1	50005
<input checked="" type="checkbox"/> 02	WLAN	224.0.1.1	50006
<input checked="" type="checkbox"/> 03	WLAN	224.0.1.1	50007
<input checked="" type="checkbox"/> 04	WLAN	224.0.1.1	50008
<input checked="" type="checkbox"/> 05	WLAN	224.0.1.1	50009
<input checked="" type="checkbox"/> 06	WLAN	224.0.1.1	50010
<input checked="" type="checkbox"/> 07	WLAN	224.0.1.1	50011
<input checked="" type="checkbox"/> 08	WLAN	224.0.1.1	50012
<input checked="" type="checkbox"/> 09	WLAN	224.0.1.1	50013
<input checked="" type="checkbox"/> 10	WLAN	224.0.1.1	50014

### CH

Message will be sent to selected channels.

### Interface

Physical LAN interface which will be used to send messages.

The interfaces are reported by OS and only active interfaces supporting multicast are listed here.

### Mcast

Multicast address to send messages.

System will join this group after starting process.

### Port

UDP port to send messages.

