Sperry Radar Interfacing

Connecting to Sperry Bridgemaster analogue radar video output and appropriate software configuration

Summary

The Sperry Bridgemaster is a widely deployed X-Band/S-Band radar that presents a broadly conventional analogue interface for video acquisition.

Successful interfacing to a Sperry radar requires the correct physical connections to be made and also a number of corresponding software settings. This application note describes the physical connection to the radar, the appropriate jumper settings on HPx cards and the appropriate software settings.

Introduction

There are two principal methods of connecting Cambridge Pixel radar acquisition cards to a Sperry Bridgemaster or other radars presenting the same interface. The first method is to connect to the transceiver output, either directly or via an interswitch unit which provides multiple copies of the radar interface signals to displays and other equipment. This interface uses three signals; radar video, sync/trigger and serial data. The second method is to use a Display Compatibility Unit (DCU) which converts the signals from the transceiver into a more conventional four-wire format: radar video, sync/trigger, ACP (Bearing) and ARP (Heading Marker).

The radar video signal is common to both interfaces and is inverted, lying between 0V (no signal) and approximately -3V (full signal), with an impedance of 75Ω.

For **transceiver output**, the trigger output is RS-422. The serial data signal combines both heading reference and azimuth pulses and is RS-422. Each azimuth pulse is represented as a serial byte (76.8kbaud), with the top bit inverting twice every scan to indicate heading marker. There are 4096 azimuth pulses per scan.

For **DCU output**, the trigger output is 10-15V positive-going into 75Ω. The azimuth/bearing pulse is a single-ended signal, with a nominal amplitude of up to 12V into 75Ω. The DCU is configurable to provide either 90 or 360 azimuth pulses per scan. If possible, 360 pulses should be selected for use with Cambridge Pixel cards. The heading marker simulates a single closing contact into a resistive load to -15V, though has been actually determined to be an open collector transistor that pulls up.

The two interface are covered in the following pages of this application note: the transceiver-based interface on pages 2 and following, and the DCU interface on pages 8 and following.

Transceiver interface

Cabling

The radar video signal will be carried on coaxial cable, while the trigger and downlink data RS-422 signals will normally be carried on twisted pair.

Suitable cables are shown in the table below.

Card type	Cable
HPx-346	346-807
HPx-400/HPx-410	124-812

The mapping of radar signals to HPx inputs is given below; please refer to the relevant HPx user manual for the actual connector pinout.

Radar Signal	Description	HPx Input
VIDEO	Analogue video	VIDA
GND	Ground pin for "OP_VIDEO"	AGND
TRIGGER +	Trigger pulse	TRGH
TRIGGER -	Trigger pulse	TRGL
SERIAL DATA +	Combined azimuth/north mark	ACPH
SERIAL DATA -	Combined azimuth/north mark	ACPL

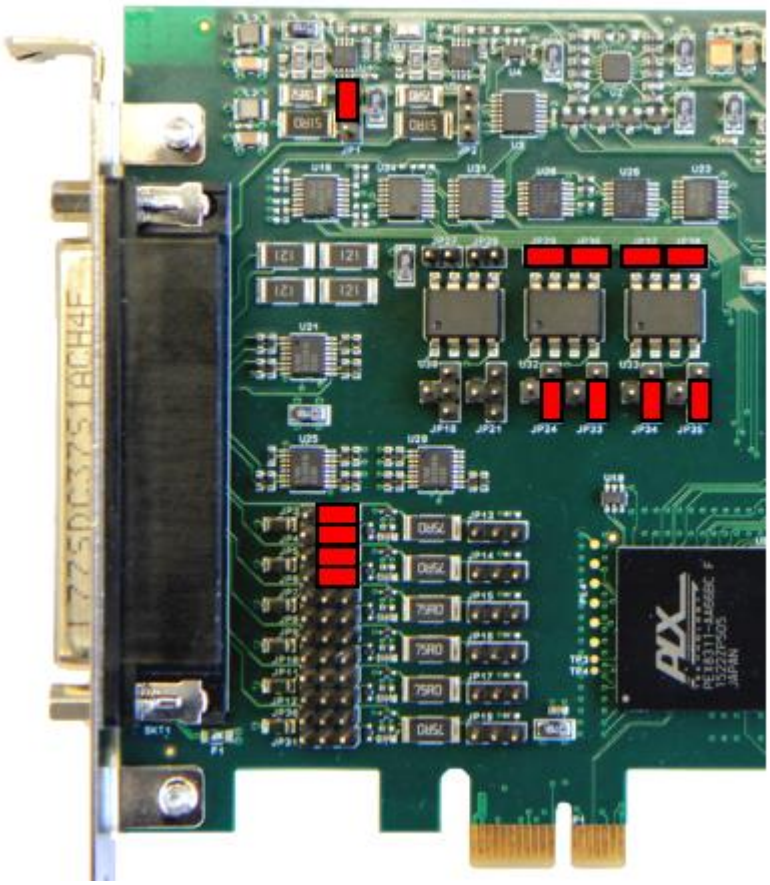
HPx Jumper Settings

The HPx radar interface hardware should be configured for 75Ω impedance video and RS-422 for the trigger and serial data signals.

The following sections summarise the link settings for each HPx radar interface card. Note that these are derived from the online link setting tool that can be found at https://www.cambridgepixel.com/support/

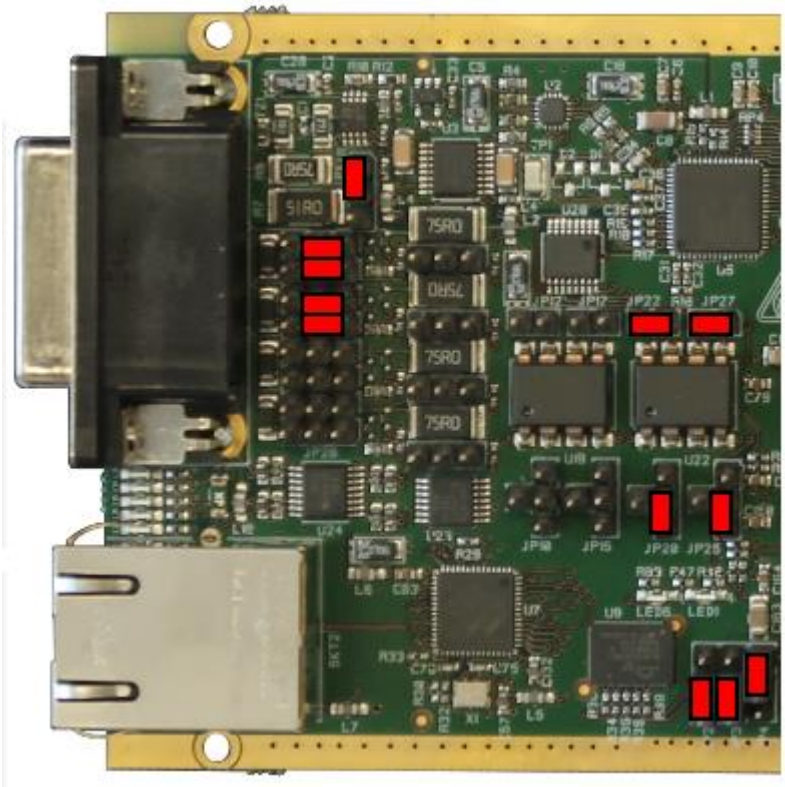
HPx-400e

Signal	Link Configuration	Description
Video	Fit: JP1 (top)	Radar video input channel A set for 75Ω.
Trigger	Fit: JP3, JP4 (right)	RS-422 differential.
ACP	Fit: JP5, JP6 (right)	RS-422 differential.



HPx-346

Signal	Link Configuration	Description
Video	Fit: 1 (top)	Radar video input channel A set for 75Ω.
Trigger	Fit: JP8, JP11 (right)	RS-422 differential.
ACP	Fit: JP13, JP16 (right)	RS-422 differential.

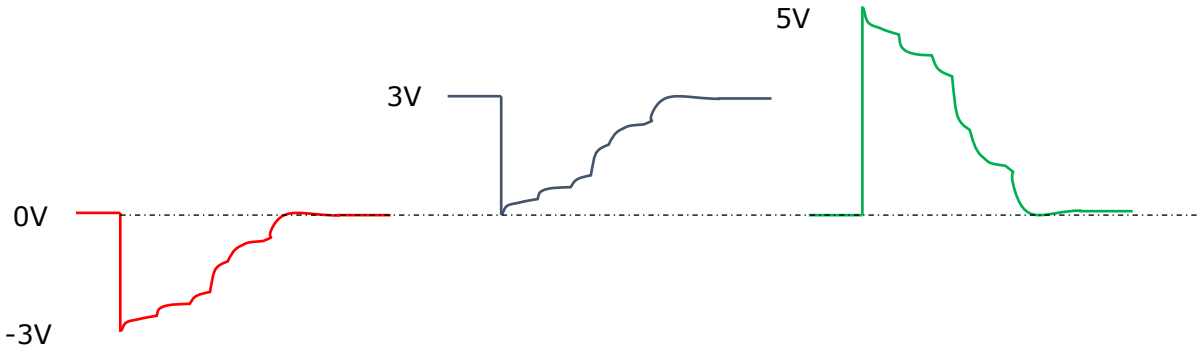


Corresponding Software Settings

Setting the links on the HPx card correctly allows the signals to be received by the card. A number of accompanying software settings are also required, in order to get the video correctly processed by the card. In the case of the HPx-346 card these settings are made through the firmware (e.g. via the web interface). For PCI, PCIe or PMC cards the controlling software may be a ready-made Cambridge Pixel application, such as SPx Server, or a custom developed application that uses the SPxHPx100Source class.

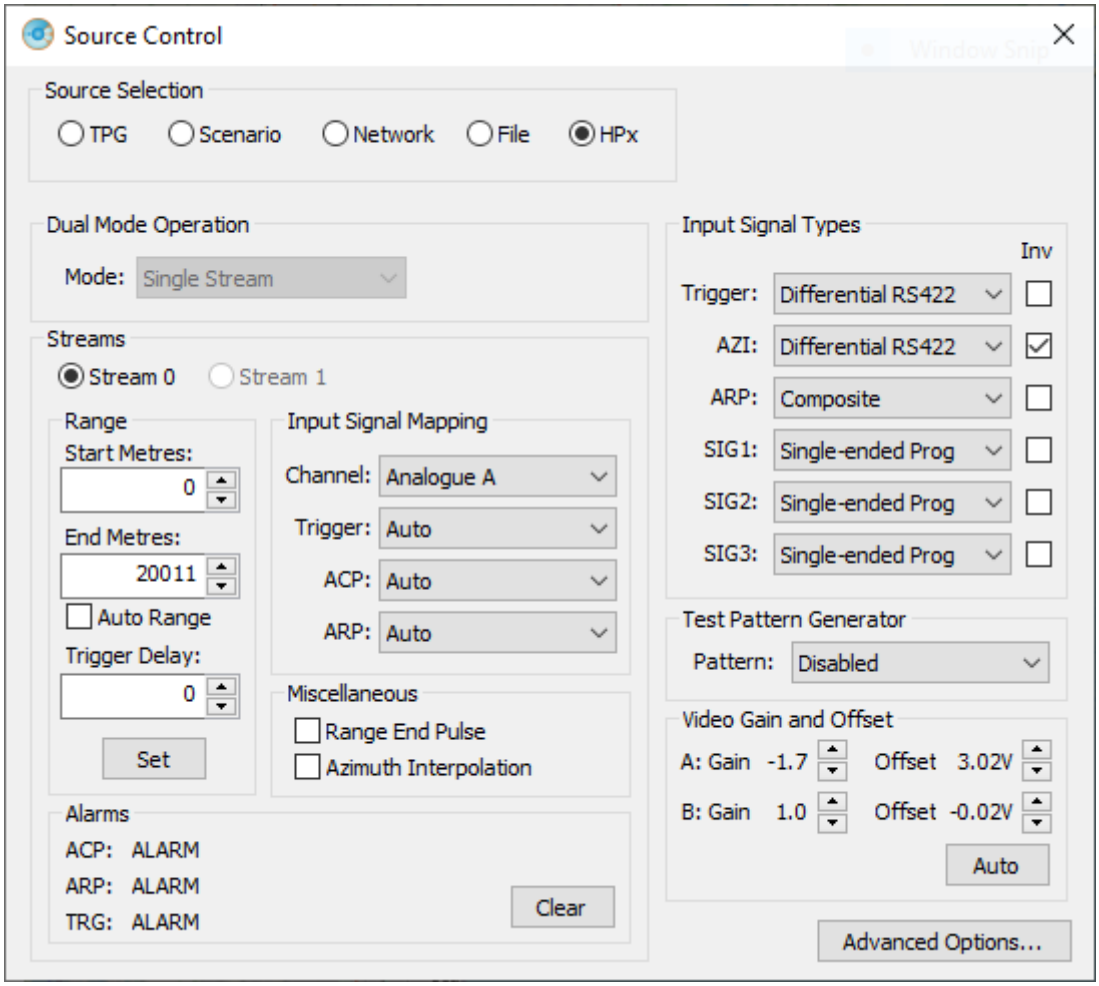
The trigger and ACP inputs should be set to differential RS-422. The ARP input should be set to Composite. The ACP input should have its "inverted" option set.

Since the radar video signal is negative, between 0V and -3V, it is necessary to invert it on the HPx card. This is simply a matter of setting appropriate offset and gain values, as depicted below.

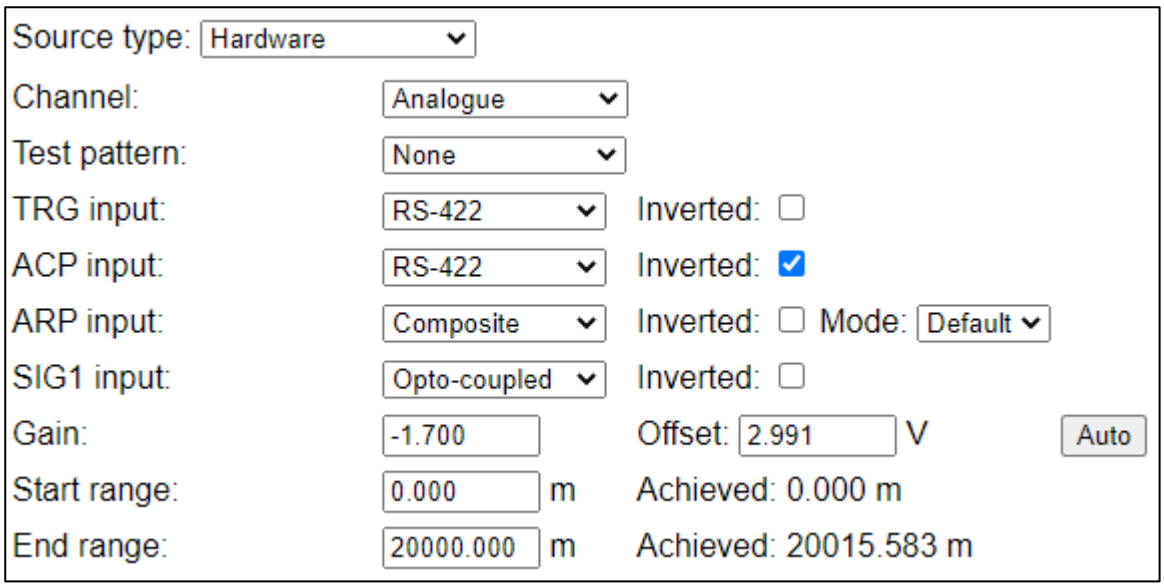


1. **The video signal coming from the radar ranges from 0V (no signal / black level) to -3V peak.**
2. **Applying an offset of +3V on the HPx card shifts the whole signal up into the range 0V to +3V. At this stage the video is still inverted; 3V is black and 0V is peak signal.**
3. **Applying a gain of -1.7 has the effect of scaling the video to fill the 0 to +5V digitisation range and inverting it so that 0V is black and +5V is peak.**

As an example, the following image shows the configuration discussed above set in the HPx source control dialog in SPx Server.



The following image shows the configuration page of an HPx-346 card.


Source type: Hardware
Channel: Analogue
Test pattern: None
TRG input: RS-422 Inverted:
ACP input: RS-422 Inverted:
ARP input: Composite Inverted: Mode: Default
SIG1 input: Opto-coupled Inverted:
Gain: -1.700 Offset: 2.991 V Auto
Start range: 0.000 m Achieved: 0.000 m
End range: 20000.000 m Achieved: 20015.583 m

DCU Interface

Cabling

All four signals will normally be carried on coaxial cable.

Suitable cables are shown in the table below.

Card type	Cable
HPx-346	346-800
HPx-400/HPx-410	124-800

The mapping of radar signals to HPx inputs is given below; please refer to the relevant HPx user manual for the actual connector pinout.

Radar Signal	Description	HPx Input
VIDEO	Analogue video	VIDA
GND	Ground pin for "OP_VIDEO"	AGND
TRIGGER	Trigger pulse	TRGH
TRIGGER RETURN	Trigger pulse	TRGL
BEARING	Azimuth pulse	ACPH
BEARING RETURN	Azimuth pulse	ACPL
HEADING MARKER (0V)	Heading pulse	ARPH
HEADING MARKER (-15V)	Heading pulse	ARPL

Note that the -15V heading marker input is connected to ARPL (opto-isolated) so that the radar interface card sees a normally-high input when HM is inactive at -15V. This means that the ARP signal is effectively inverted so that a 1 to 0 transition indicates leading edge of ARP.

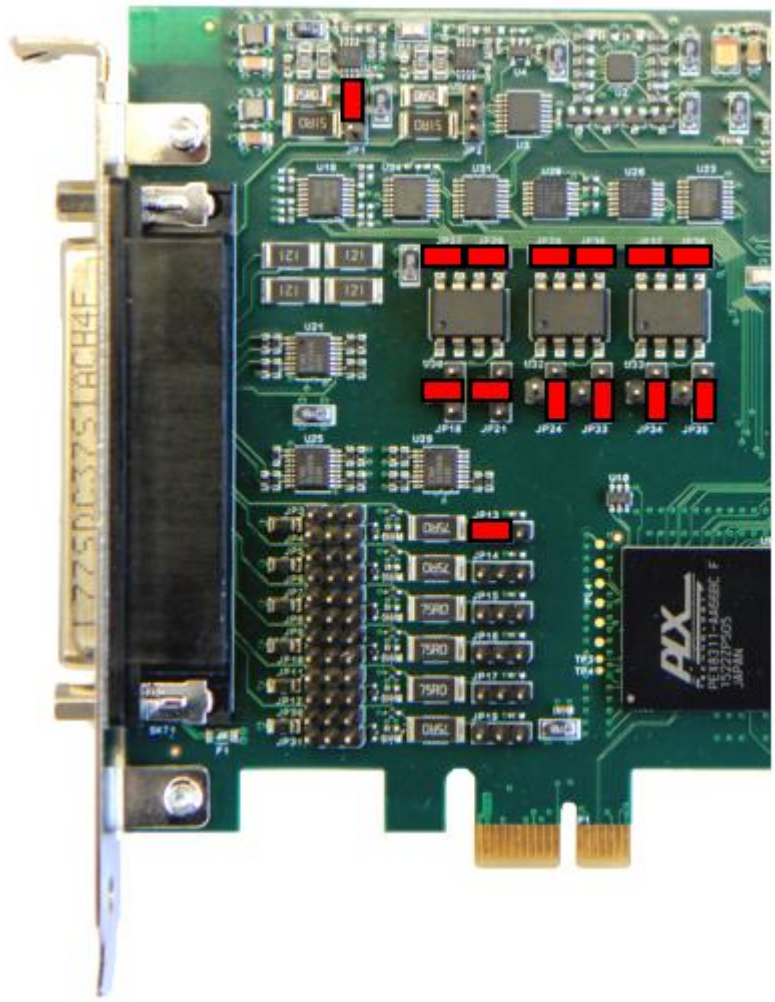
HPx Jumper Settings

The HPx radar interface hardware should be configured for 75Ω impedance video and trigger inputs, and high impedance for bearing and heading inputs.

The following sections summarise the link settings for each HPx radar interface card. Note that these are derived from the online link setting tool that can be found at https://www.cambridgepixel.com/support/

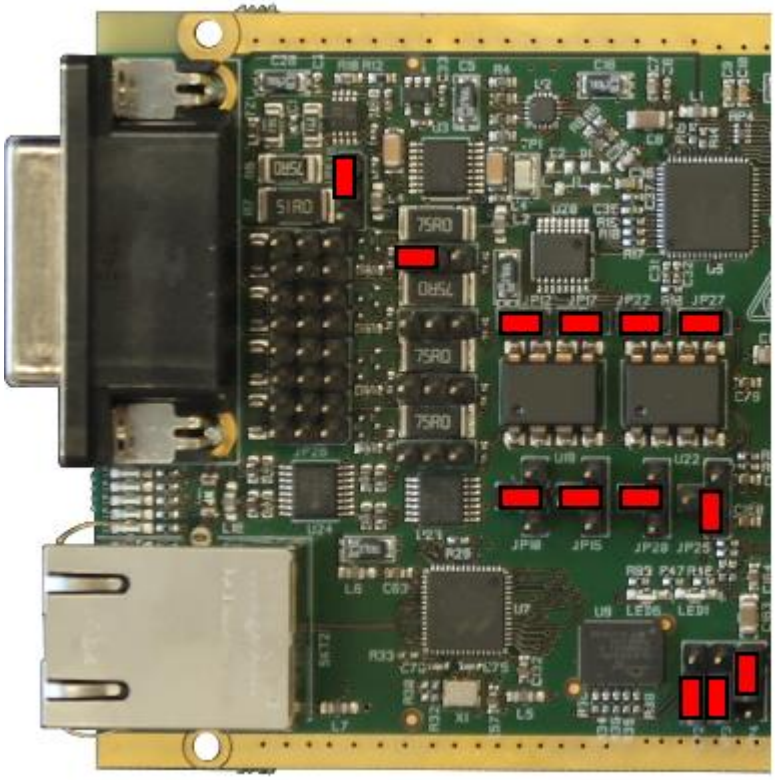
HPx-400e

Signal	Link Configuration	Description
Video	Fit: JP1 (top)	Radar video input channel A set for 75Ω.
Trigger	Fit: JP27, JP18 (centre), JP13 (left)	Opto-isolated, 6-25V, 75Ω termination.
ACP	Fit: JP28, JP21 (centre)	Opto-isolated, 6-25V, no termination.
ARP	Fit: JP29, JP24 (centre)	Opto-isolated, 6-25V, no termination.



HPx-346

Signal	Link Configuration	Description
Video	Fit: 1 (top)	Radar video input channel A set for 75Ω.
Trigger	Fit: JP12, JP10 (centre), JP9 (left)	Opto-isolated, 6-25V, 75Ω termination.
ACP	Fit: JP17, JP15 (centre)	Opto-isolated, 6-25V, no termination.
ARP	Fit: JP22, JP20 (centre)	Opto-isolated, 6-25V, no termination.



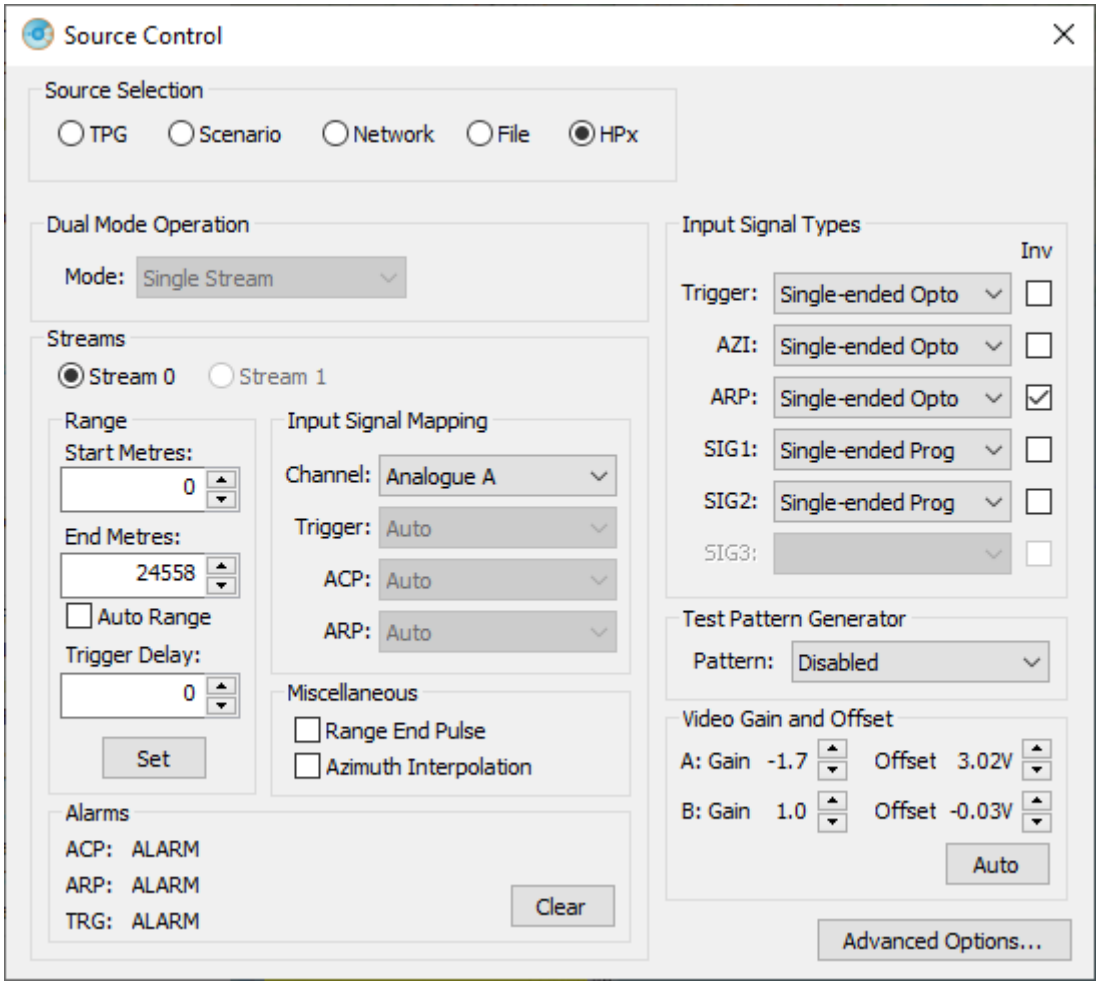
Corresponding Software Settings

Setting the links on the HPx card correctly allows the signals to be received by the card. A number of accompanying software settings are also required, in order to get the video correctly processed by the card. In the case of the HPx-346 card these settings are made through the firmware (e.g. via the web interface). For PCI, PCIe or PMC cards the controlling software may be a ready-made Cambridge Pixel application, such as SPx Server, or a custom developed application that uses the SPxHPx100Source class.

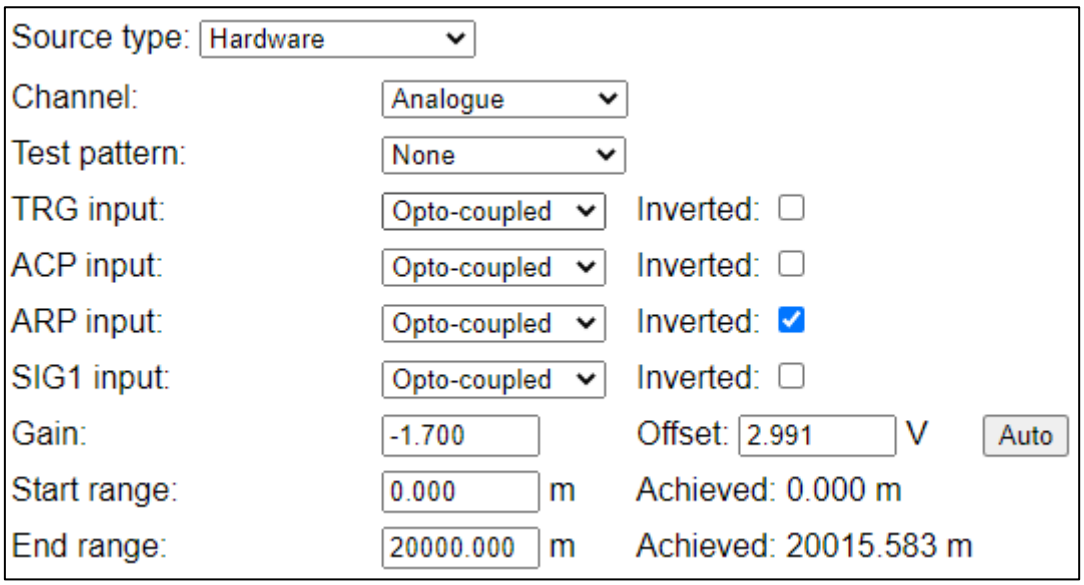
The trigger, ACP and ARP inputs should be set to opto-coupled. The ARP input should have its "inverted" option set.

Since the radar video signal is negative, between 0V and -3V, it is necessary to invert it on the HPx card as described on page 5.

As an example, the following image shows the configuration discussed above set in the HPx source control dialog in SPx Server.



The following image shows the configuration page of an HPx-346 card.



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