# Model C10PS/SP
# Parallel to Serial / Serial to Parallel Converter

## INTRODUCTION

The C10 parallel/serial converter products are designed to efficiently adapt 8 or 10 bit parallel digital video equipment to serial digital interfaces. The C10 converters attach directly to the "D" connectors of parallel equipment – eliminating the need for expensive and un-reliable parallel cables. At only .65 inches (16.5mm) wide, the C10 converters can fit on even the highest density parallel equipment.

The C10 products can be powered from a small wall plug-in power supply (provided). An optional rack-mount supply can power up to 24 C10 converters.

An exclusive feature of the C1- converters are their signal processing functions. Controlled by external dip-switches, these functions address the problems of integrating 8 and 10 bit digital equipment. The dither mode properly converts 10 bit video to 8 bit resolution. This function is useful when feeding 8 bit equipment, such as VTRs and DVEs, with 10 bit equipment such as a switcher. The 8-to-10 bit input format mode is useful when feeding 10 bit equipment/system with 8 bit equipment that only drives 8 data bits of the interface.

AJA's signal processing functions simplify digital systems by taking 8/10 bit format control out of operations and making it a one-time set-up at installation time. By converting 8 bit parallel equipment to 10 bit compatible serial digital, systems can be standardized at 10 bit serial digital.

## SPECIFICATIONS

| | |
|---|---|
| **Serial Interface** | SMPTE |
| **Parallel Interface** | SMPTE 125M (4:2:2)<br>SMPTE 244M (4fsc NTSC)<br>EBU Tech. 3246/3247 (4:2:2)<br>IEC 60B 170/5 (4fsc PAL) |
| **Serial Input** | |
| **Return Loss** | > 15 db, 5 – 270MHz |
| **Cable EQ** | 0 – 300 meters typical, Belden 8281 |
| **Serial Outputs** | |
| **Return Loss** | > 15 db, 5 – 270 MHz |
| **Risetime** | 600 ps typical |
| **Jitter** | **C10SP:** 250ps pp typical (w/250ps pp input jitter)<br>**C10PS:** 250ps pp typical (w/.5 – 1ns pp input jitter) |
| **Level** | 800mv, ±10mv (adjustable ±200mv) |
| **Power Requirements** | 5 VDC regulated, 600 ma max. |
| **Operating Temp.** | 0 ° to 40 ° C (32 ° to 104 ° F) |

## OPERATION INFORMATION

### Input/Output

**C10PS Parallel Input** 27mhz, 14.3mhz, or 17.7mhz parallel digital

**Serial Output** 270mb, 143mb, or 177mb serial digital, separately buffered (follows input)

**C10SP Serial Input** 270mb, 143mb, or 177 mb serial digital

**Serial Output** Active serial input loop-through – equalized and re-clocked (signal processing functions do not affect this output)

**Parallel Output** 27mhz, 14.3mhz, or 17.7mhz parallel digital (follows input)

**Lock Indicator** The green LED lock indicator will light when power is applied and the unit is locked to a valid input

**Power** The C10 products require 5 volts DC regulated at 600 ma max. Current draw is typically 550 ma for component and 400 ma for composite. The power connector wiring is shown in Fig. 1.

### Installation

The C10 products are designed to attach directly to the parallel "D" connectors of digital video equipment. The units may also be connected to parallel digital video cables by using a female-to-female adapter. Note that appropriate parallel cables and adapters are required for proper operation at digital video frequencies.

### Signal Processing Functions

Most installations use the C10 products with the signal processing functions in the factory default settings. The signal processing functions may be used if the specific functions, as explained below, are needed. **If you are interconnecting 8 and 10 bit equipment**, see the **INPUT** and **DITHER** functions.

**INPUT FUNCTION** selections: 8 bits / 10 bits **factory default: 10 bits**

The INPUT function allows the user to specifically define the input as either 8 or 10 bits. This function will properly format 8 bit input video when the 8 bit source does not driving newer 10 bit of the interface. This function is often

needed when older 8 bit equipment is driving newer 10 bit equipment (e.g., driving Digital Betacam with an 8 bit disk). Note that the 10 bit selection will also pass 8 bit information transparently (but will not format the 2 lower unused bits).

**DITHER FUNCTION** selections: ON/OFF **factory default: OFF**

The DITHER function will properly reduce 10 bit input video to 8 bit resolution using a randomized rounding algorithm. This function is useful when newer 10 bit equipment (e.g., Digital Betacam, D5) is driving older 8 bit equipment.

**ANC STRIP FUNCTION** selections: ON/OFF **factory default: OFF**

The ANCILLARY DATA STRIP function will remove all ancillary data (audio, etc.) from the input digital video signal. When ANC STRIP is ON, the C10 units will pass only video and sync data. This function essentially regenerates the blanking interval – this allows it to remove even illegal data in the blanking areas as a proc amp would. Note that this function is applicable to component video only – ancillary data is not allowed in the parallel composite digital interface standard. The C10SP will always remove ancillary data from serial composite digital video.

**AUX FUNCTION** selections: ON/OFF **factory default: OFF**

The AUX function does nothing and is reserved for future use.

## ADJUSTMENT PROCEDURES

**CAUTION: These products contain electrical components that are susceptible to damage from static discharge. Any adjustment or maintenance should ne done only at a static-free workstation by qualified personnel.**

### C10PS, C10SP Serial Digital Output Level

1. Remove the bottom cover.
2. Connect a validdigital video input.
3. Connect a waveform monitor or oscilloscope to the serial output – be sure

the serial output is properly terminated with 75 ohms.

4. Adjust **R18** (C10PS), or **R34** (C10SP) for a peak-to-peak output level of 800mv.

### C10SP Serial Rx VCO Adjustment

The serial digital receiver VCO (voltage controlled oscillator) adjustment sets the "free run" frequency to the optimum point. This adjustment accounts for differences occurring in the chip manufacturing process and is not normally changed in the field. The C10SP should be warmed-up for at least 5 minutes before making these adjustments. The adjustments are accessed by removing the top cover of the C10SP.

### Composite serial digital

**NOTE:** Both R3 (143 mb adjustment) and R2 (177 mb adjustment) have enough range to "lock" to either rate. If the proper adjustment has no effect, then the other must be "de-tuned" until the proper pot (R3 for 143 mb, R2 for 177 mb) can be set. "Locking" the C10SP with the wrong pot will cause improper operation.

### Composite NTSC – 143 mb

1. Connect a composite NTSC serial digital source to the C10SP input.
2. Connect a picture monitor to the C10SP output (serial or parallel).
3. While monitoring the LOOP FILTER VOLTAGE appearing on **pin 1 of R4** (Fig. 2), adjust **R3** and lower (make more negative) the loop filter voltage until there os a loss of video (this indicates the VCO is unlocked, - also, the green "LOCK" LED in the C10SP will go out).
4. Slowly increase the loop filter voltage (**R3**) until stable video re-appears. Note the loop filter voltage.
5. Set the LOOP FILTER VOLTAGE (**R3**) to a point 200 mv about the value meansured in step 4.

### Composite PAL – 177 mb

1. Connect a composite PAL serial digital source to the C10SP input.
2. Connect a picture monitor to the C10SP output (serial or parallel).
3. While monitoring the LOOP FILTER VOLTAGE appearing on **pin 1 of R4** (Fig. 2), adjust R2 and lower (make more negative) the loop filter voltage until there is a loss of video (this indicates the VCO is unlocked, - also, the green "LOCK" LED on the C10SP will go out).

4. Slowly increase the loop filter voltage (**R2**) until stable video re-appears. Note the loop filter voltage.
5. Set the LOOP FILTER VOLTAGE (**R2**) to a point 200 mv about the value measured in step 4.

## APPLICATION INFORMATION

### Converting Between 10 and 8 Bit Video with the C10 Parallel/Serial Converters

In addition to converting between parallel and serial digital video formats, both the C10PS parallel-to-serial and C10SP serial-to-parallel converter products can also convert between 8 and 10 bit video formats. These functions are useful when:

- Integrating 8 and 10 bit equipment that does not provide the appropriate 8/10 bit conversion functions. For example, feeding an 8 bit VTR with a 10 bit switcher that does not support 10-to-8 bit conversion.
- Integrating 8 and 10 bit equipment in a system. When digital outputs feed a system or router, and the system has both 8 and 10 bit destinations, controlling the source format (8/10 bit) becomes a problem. However, if the 8 bit equipment in the system is converted to "10 bit compatible" (i.e., 10/8 bit convert at 8 bit inputs and properly format 8 bit outputs) then the system can be specifically "10 bits" and all input/output format controls can be permanently set.

The C10's 10/8 bit signal processing functions simplify digital systems by converting 8 bit equipment to "10 bit compatible". The functions are controlled by dip-switches accessible on the back. Note that when in the factory default settings (all functions "OFF") the C10 converters operate in a transparent mode for both 8 and 10 bit data.

The remainder of this section explains the C10's signal processing functions in detail.

**Feeding 8 bit equipment with 10 bit equipment**

When a 10 bit source is feeding an 8 bit destination, it is important that the 10 bit data be reduced to 8 bit resolution in an appropriate manner, as opposed to truncation or "throwing away" the 2 least-significant bits (LSBs). Failure to do so will result in visible artifacts, particularly in the form of striations or "contour" lines in "ramp" or gradient areas of the video.

Most digital veterans know this problem well – it has been the source of many headaches, and more than a few rejected masters. The proper way to convert from 10 to 8 bits is to use a dithering algorithm (or equivalent). The dithering technique has been well known for many years (it dates back to digital radar research in the 1950's) [1] [2]. Essentially, the dithering algorithm uses the data to be discarded (the 2 lower bits in this case) and a

"white" noise source to "randomize" the round-off error. Note that this technique is more sophisticated than simply "adding noise" to the signal as it does retain some of the information from the two 10 bit LSBs – in the form of "weighted" noise. "Randomized rounding" for the 10-to-8 bit conversion is recommended in SMPTE 125M Annex G.

Traditionally, digital video equipment has addressed the 10-to-8 bit problem by providing the processing and control at digital outputs, i.e., a switch to set the resolution of the output.
The problems with this scheme are:

1. the switch must be controlled by operations when feeding both 8 and 10 bit equipment
2. the digital output cannot simultaneously feed both 8 and 10 bit equipment (without disadvantage)
3. the switch may be "inadvertently" used in the wrong position
4. the digital output may not have the resolution (8/10 bit) control switch

It would simplify the situation considerably if the resolution reduction occurred at the *input* of 8 bit equipment. In this scenario, all the problems listed above go away – the interconnections between equipment (or system, router, etc.) can be standardized at 10 bits, and the 8/10 bit control switches would be set at installation time only.

The C10 converters (both the C10PS and C10SP) provide this capability with their 10-to-8 bit dithering function. The C10SP converters can be placed at the parallel inputs of 8 bit equipment and transform those inputs into 10 bit (compatible) serial inputs. This capability is useful even if the 8 bit device already has both serial and parallel inputs (e.g., VTR).

**Feeding 10 bit equipment with 8 bit equipment**
The situation here is more subtle than the above, but there are still potential problems. An 8 bit signal can be converted to a 10 bit signal simply by using the 8 most significant bits of the 10 bit interface and setting the two LSBs to zero, as specified by SMPTE 125M section 2.2 and 244M section 3.3. If this is not done, there are potential problems:

1. noise may be present in the 2 LSBs which could degrade the signal if not handled properly downstream
2. the values of 1,1 for the LSBs can cause improper decoding of sync and/or flag data in some equipment

Although the standards do specify that 8 bit outputs should set the two 10 bit LSBs to zero, most of the 8 bit equipment that was built before the standards were proposed, and a considerable amount that was built after, does not meet the standards, i.e., the 2 LSBs are undefined or "floating".

Again, this situation has been handled traditionally by yet more switches – this time "input resolution" (8/10) switches on 10 bit equipment (e.g., switchers). The potential problems with this scheme are:

1. the switch must be controlled if the source is variable (e.g., from a router)
2. the switch may be "inadvertently" used in the wrong position
3. the digital input may not have the resolution (8/10 bit) control switch

Again it would simplify the situation considerably if the non-standard 8 bit outputs were "standardized" *at the 8 bit outputs*, and the system was left at 10 bit resolution. All the problems listed above then go away.

The C10 converters (both the C10PS and the C10SP) provide this capability with their "INPUT" function. This function will format 8 bit inputs, both video and flags, such that it conforms to the interface standards. The C10PS converters can be placed at the parallel outputs of non-standard 8 bit equipment and transform those outputs into 10 bit (compatible) serial outputs.

**Ancillary Data**

Ancillary data is data other than video that is present in the serial or parallel interface (except composite parallel). Audio, Error Detection, and User Data are examples of ancillary data. Because the ancillary data capability was added to the proposed standards after a considerable amount of equipment was built, some equipment may not be prepared to accept it. The C10 converters (both the C10PS and C10SP) provide a filter which will block ancillary data and pass only the video and sync information. This function is also useful in some test and maintenance situations.

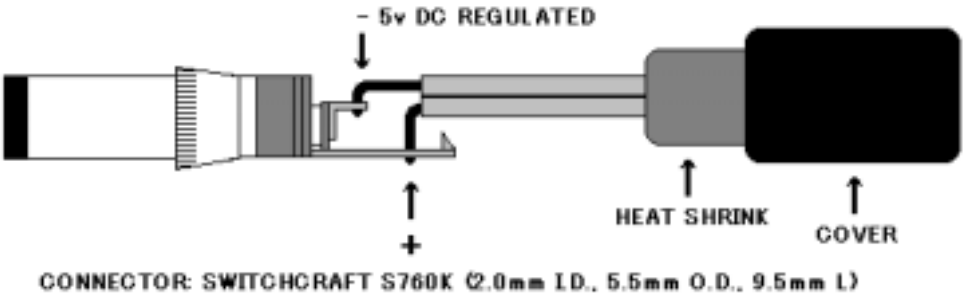
Note that this function is not applicable to composite video because the parallel composite standard (SMPTE 244M) does not allow ancillary data – C10SP serial-to-parallel converter will always remove ancillary data from composite video.

References:

[1] L.G.Roberts, "Picture Coding using Pseudo-Ramdom Noise", IRE Tramsactions on Information Theory, vol. 8 pp. 145-154, February, 1962.

[2] L. Schuchman, "Dither Signals and Their Effect on Quantization Noise", IEEE Transactions On Communications Technology, vol. COM-12, pp. 162-165, December 1964.

[3] N.S Jayant – P. Noll, "Digital Coding of Waveforms", Prentice-Hall, TK5102-J39, pp. 164-175, 1984.




***CAUTION! POSITIVE GROUND***

FIGURE 1
C10 POWER CONNECTOR WIRING

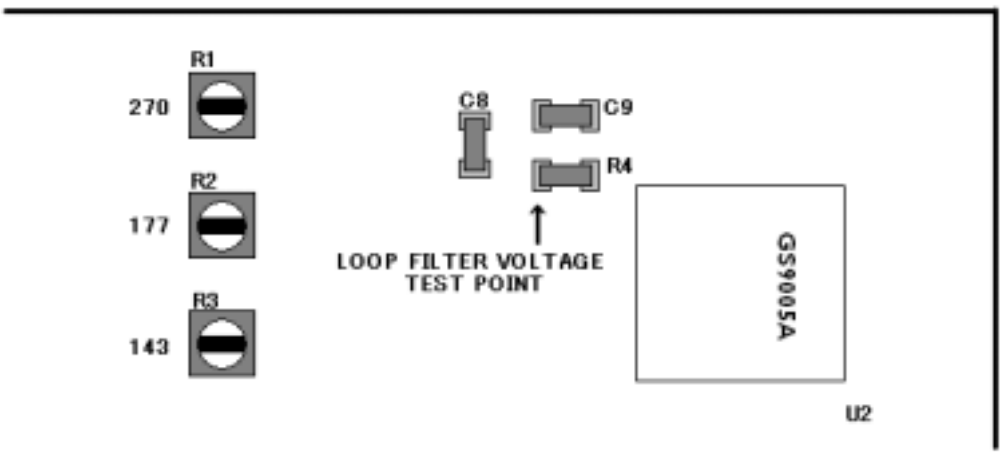



FIGURE 2 C10SP VCO ADJUSTMENT