

# COHU INC. Electronics Division

## Technical Reference Manual

### 6600-3000 Digital Output Progressive Scan Camera

Technical Manual 6X-997  
(for version 8128-8)

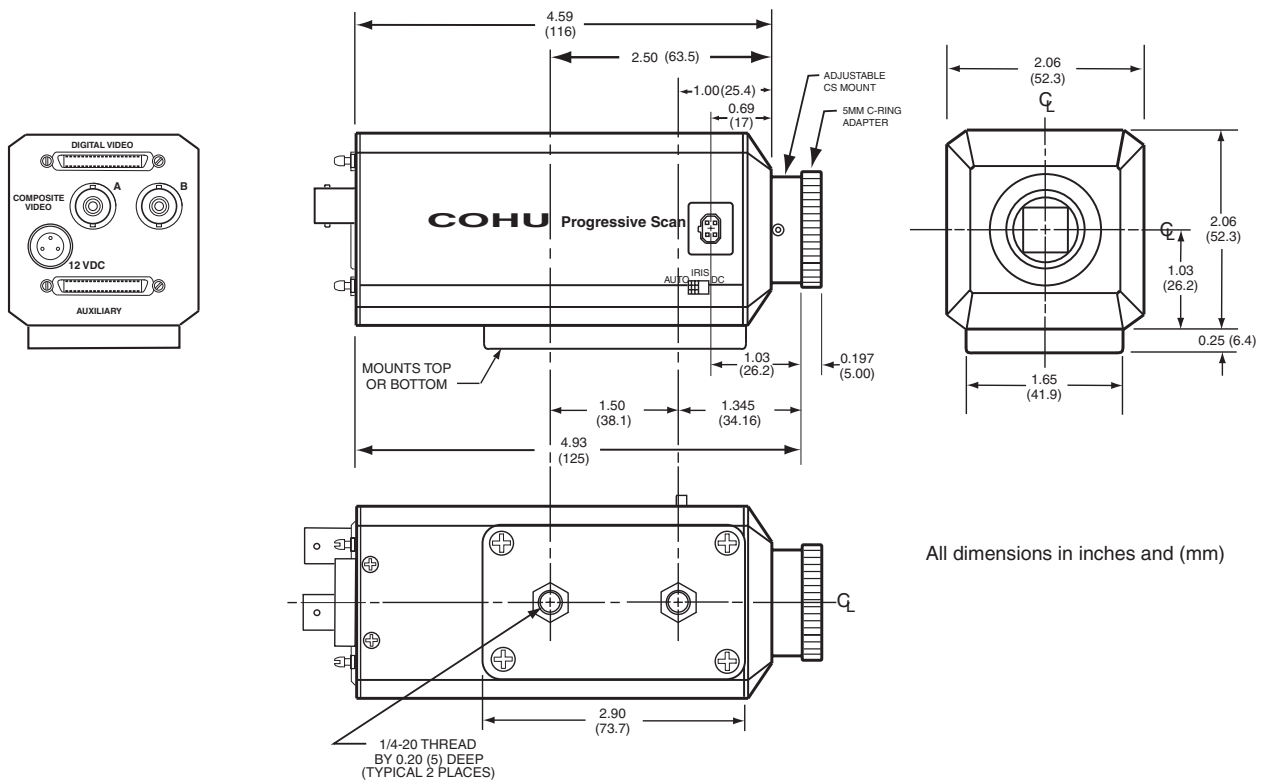
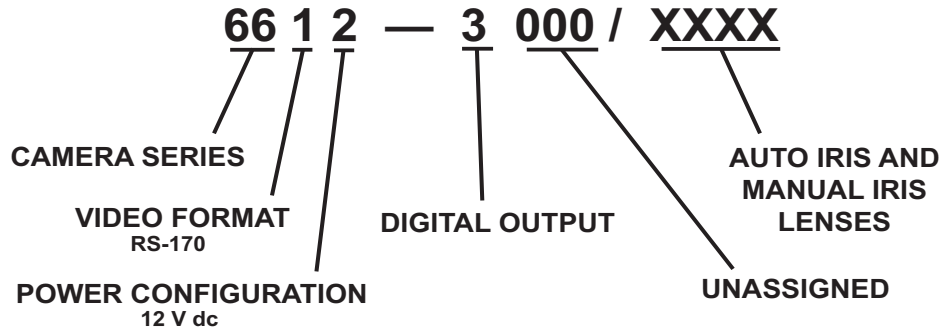


Figure 1. Dimensions

September 25, 2001  
6X-997

**Table 1. Specifications**

Imager	Monochrome, 1/2-inch format, interline transfer square pixel array
Format	Selectable: Interlaced, RS-170, 1 Vp-p Non-interlaced, 60 frames/sec, one connector, 1 Vp-p LVDS digital video, one D-connector, 10-bit parallel data, horizontal, vertical, composite sync, and pixel clock
Pixel Array	659 (H) × 494 (V)
Pixel Rate	12.2727 MHz
Cell Size	9.9 μm × 9.9 μm
Sync	Internal crystal, external H&V and asynchronous reset. Async reset triggers output of one frame of data at exposure set by shutter controls followed by blanked output with H sync. Stability <20 ns; jitter <25 ns
Sensitivity	Full video, no agc: 4 lux 80% video, agc on: 0.15 lux (3200 K faceplate illumination)
Gain	Agc/manual adjustable to 28 dB. Internal, external, or remote control via aux connector
S/N Ratio	56 dB (gain 0, gamma 1, 0 to 6 MHz bandwidth)
Gamma	0.45 to 1.0, continuously adjustable
Sharpness	Selectable from minimum to maximum, affects both analog and digital
Integration	Switch or externally selectable 8-step shutter (1/60 to 1/10,000). External control os shutter mode, shutter speed, H&V, async reset, and integration through Aux connector
Output	20 bit, low voltage differential signal (LVDS), 10-bit each channel
Lens Drive	Switch selectable, auto iris drive (video), or dc iris drive (dc level)
Output Cable	40 foot/ 12 meter maximum length typical with CAT 3 cable 200 foot/60 meter maximum length typical with CAT 5 cable
Power	12 V dc
Approvals	FCC class A; CE EN55022, 50081-1, EN50082-1
Reliability	MTBF: 20,000 hours (less lens)
<b>MECHANICAL</b>	
Lens Mount	C/CS
Camera Mount	1/4-20 female thread, top and bottom of housing in line with optical axis
Weight	11 oz (320 grams) without lens
Shock	No damage to 30 g, 11 ms duration (less lens)
Vibration	Per MIL-STD-810 (E) Method 514.4 Categories 1, 8, and 10 (less lens)
<b>ENVIRONMENTAL</b>	
Humidity	Up to 95% relative humidity , non-condensing
Altitude	Sea level to 10,000 feet (3000 meters) [508 mm/20-inch Hg]
Temperature	-4 °F to 158 °F (-20 °C to 70 °C)



#### Accessory Items

115 Vac to 12 Vdc 1000 mA Power Pack: Part No. 8385-5

Connector, 0.8 mm Plug: Part No. 1310450-050

Connector, backshell kit: Part No. 1310450-150

**Figure 2. Model Number Interpretation**

## 1.0 ELECTRICAL CHARACTERISTICS

The 6600-3000 (figure 1) is an interline transfer progressive scan camera with video output in both analog and digital format. Figure 2 is a model number interpretation diagram describing what each number designates. Specifications are given in table 1. A sensor response diagram is shown in figure 3.

It can operate at either 60 frames per second (fps) or 30 fps. At 60 fps video is output through two channels, each containing the opposite field of an interlaced — RS-170(A) — frame. At 30 fps video is output through a single channel formatted as a single frame of sequential lines.

Figure 4 is a functional block diagram illustrating major features of the camera.

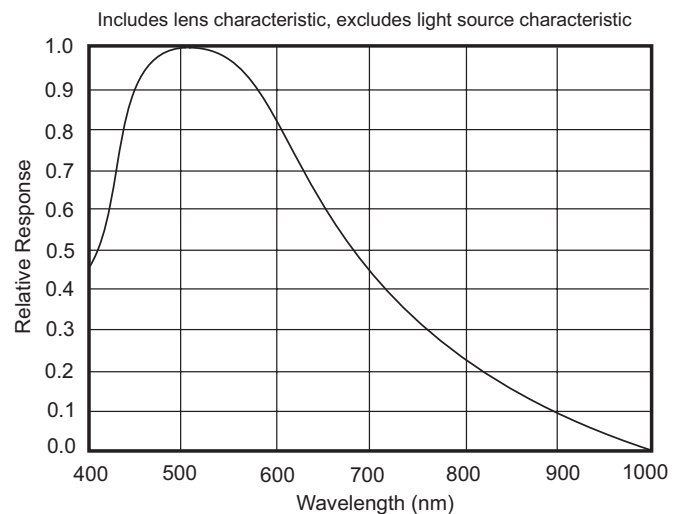
Each video channel is output through a BNC connector at 1 V p-p with RS-170(A) sync.

Note: In 60 fps continuous mode each channel alternates transmission of odd and even fields just as with RS-170(A).

Digital output is available at a 50 pin connector on the rear panel in 10-bit format.

A 50-pin auxiliary connector on the rear panel provides multiple control inputs for various functions. This includes shutter/integration selections, sync modes, asynchronous reset triggering, H & V triggering input, and other functions. See table 2.

Switches and potentiometers on the internal circuit boards also provide selection of control functions including sync modes, shuttering, gamma and setup.



**Figure 3. Sensor Response**

**Table 2. Auxiliary Connector Pin Identification**

Pin. No.	Signal Name	Input/ Output	Level	Description
1	EDI 0	Input	TTL	Shutter/integration control. Refer to mode and control configuration table for selections
2	EDI 1			
3	EDI 2			
4	SMD 1	Input Input	TTL	Shutter/integration control. Refer to mode and control configuration table for selections
5	SMD 2			
6	EXT	Input	TTL	Sync mode. External sync (TTL high) locks to vertical trigger (VT) or to horizontal trigger (HT). Internal sync (TTL low) provides a crystal reference
7	RM	Input	TTL	Video mode. Progressive scan (TTL low) provides 30 fps through a single channel progressive scan output Interlaced (TTL high) provides 60 fps through dual channels
8	RDM	Input	TTL	Trigger mode. Normal (TTL low) is continuous operation; asynchronous reset, Donpesha (TTL high) provides snap shot operation
9	REXH	Input	TTL	Direct reset mode enable (TTL level). Enable Asynch reset: H/V when high
10	REXD	Input	TTL	Direct reset mode enable (TTL level). Enable Asynch reset: V or H/V when high
11	PLEN	Input	TTL	Reserved for future use
12	ARESET	Input	TTL	Asynchronous reset. Triggers on negative-going edge. (TTL levels)
13	HTSG/	Input	TTL	Integrate enable. Allows external control of integration period. (Modes 5, 12, & 19) integrate when low. Outputs a single image on next vertical interval following HTSG/ going high
14	VT	Input	1.5Vp-p ac coupled	Vertical trigger (TTL level). Used for external sync modes. Triggers on negative-going edge. Neg pulse = 127 $\mu$ s minimum (2H period)
15	HT	Input	1.5Vp-p ac coupled	Horizontal trigger (TTL level). Used for external sync modes. Triggers on negative-going edge. Neg pulse = 0.3 $\mu$ s minimum
16	nc	—	—	Reserved
17	REMGAIN	Input	Analog	Remote gain. External control of manual gain with voltage or resistance. Max gain = 0 V or 2.4 kohm.
18	REMBAL	Input	Analog	Remote channel balance. External control with voltage or resistance. Max channel A, minimum channel B). Min Chan A (Max chan B) = 4.2 V or 1 megohm
<i>(Continued)</i>				

Pin. No.	Signal Name	Input/ Output	Level	Description
19	nc	—	—	
20	+12V in	Input	dc	Optional camera power input (pins 45 & 46 are power return)
21				
22	WEN/	Output		Write ENable pulse (TTL level). Goes low at start of video frame.
23	HDD	Output	TTL	Horizontal drive output
24	PIXCLK/	Output	TTL	Pixel clock (TTL level). 12.272 MHz. Pixel aligned with negative edge.
25	VDD	Output	TTL	Vertical Drive Ouput
45	+12 V return	Input	dc (GND)	Return for camera power pins 20 & 21
46				

*Note: Pins 26-43 & 47-50 are grounds (GNDD); pins 41 & 44 are no connection.*

ITEM	DESCRIPTION	QTY	PART NUMBER
1	Plug, Power Cable, 3-pin, Switchcraft TA3F (note 1)	1	1310356-103
2	Plug, Lens Cable, 4-pin, (note 1)	1	1310419-004
3	Wrench, Hex Key, 0.050 (note 1)	1	9710010-009
4	Setscrew, Stainless, Socket Head, Nylon Tipped, 4-40 x 5/32	1	2010258-005
5	CS mount adapter	1	8359208-001
6	5 mm Extender, CS-to-C mount adapter	1	2010695-001
7	Base, Mounting Block (see figure 1)	1	8401019-001

*Notes: 1. Part of accessory kit 8385-9*

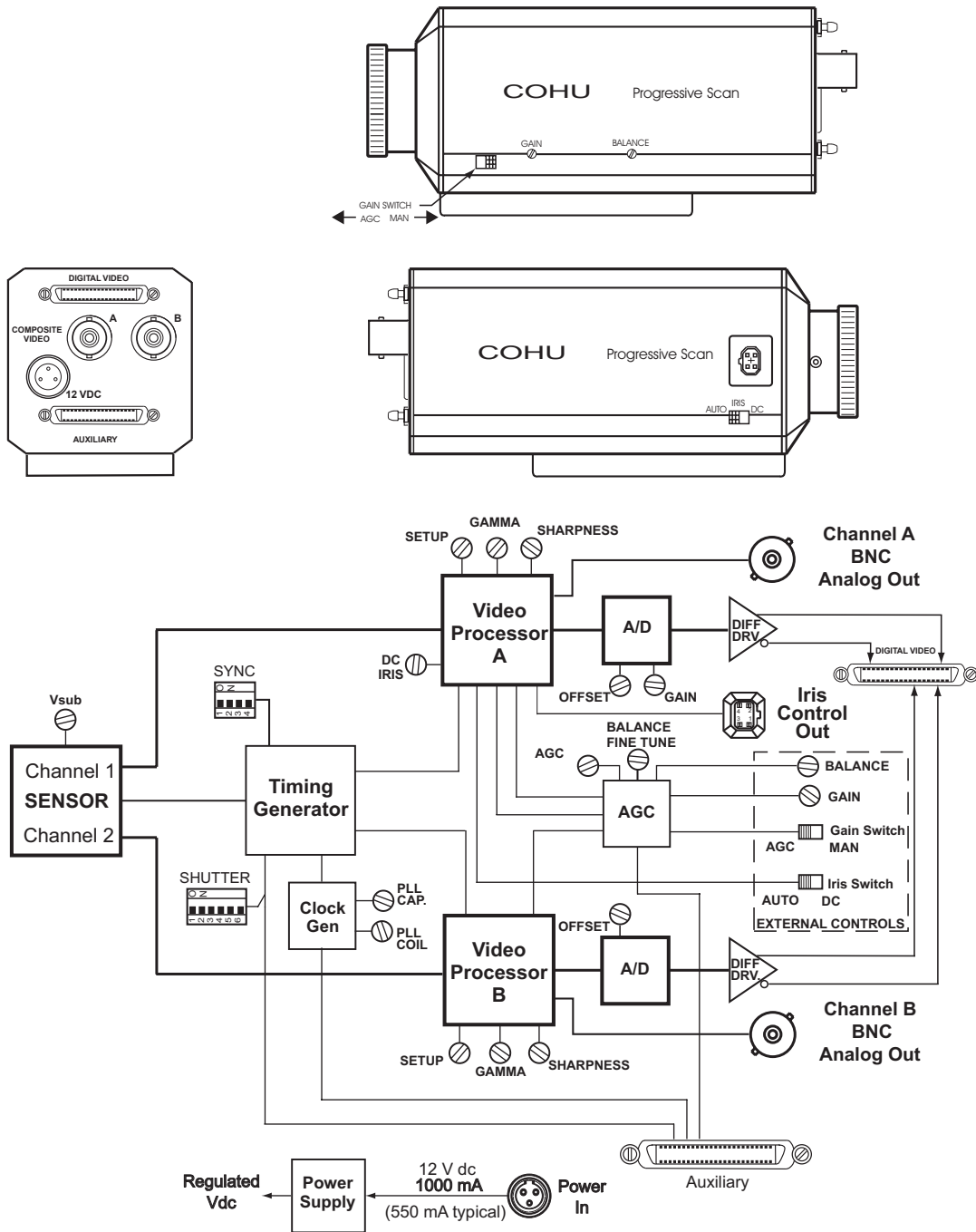


Figure 4. Camera Functional Diagram

## 2.0 MECHANICAL CHARACTERISTICS

Figure 1 illustrates dimensions of the camera. The camera chassis consists of a full width U-shaped bottom rail to which attaches a vertically mounted front casting and rear plate. Four screws secure these chassis parts together, two at front and two at rear.

The casting is threaded to accept a CS-mount lens from the front. The sensor board mounts to the back side of the casting with a screw at each corner.

The rear panel mounts two BNC connectors, two 50 pin connectors, and a 3-pin power connector.

The main board mounts inside the bottom rail on four standoffs. This board positions the lens iris selection switch, auxiliary connector, and power input connector for access from outside the camera when the cover is installed.

The digitizer board mounts about 1.3 inch (33 mm) above the main board. It mounts at the corners to three standoffs and a bracket.

The cover is shaped like a flat bottomed U and open at the two ends. It slides down over the chassis from the top. Four screw holes on top of the cover (2 front, 2 rear) provide for securing it to the front casting and rear plate.

Before disassembling make note of any spacing or lock washers on the standoffs. These may be used during assembly to prevent components from shorting to the chassis or other components.

Field disassembly is typically limited to removing the cover to make any required adjustments or changes to switches.

## 3.0 EQUIPMENT SUPPLIED

Table 3 lists the various items supplied with the camera. Some of these are normal parts of the camera and others are supplied loose as accessory items. A lens and power supply can be ordered with the camera if desired.

## 4.0 EQUIPMENT REQUIRED BUT NOT SUPPLIED

The intended use largely determines what equipment is required to make use of the camera. The following list offers typical supporting items required to make full use of the camera. Items 1 and 2 are usually ordered with the camera.

1. Power supply, 12 V dc, 1000 mA
2. Lens, manual, auto iris or dc iris with either a CS or C-mount
3. Frame grabber, digital input, 1 - or 2-channel (or analog input if it is desired to use those outputs)
4. External sync source with H and V trigger outputs
5. Auxiliary input control (see figures 7 and 8)
6. 75 Ohm coaxial cables (for analog video output)

## 5.0 INTERFACE CONNECTORS

Table 4 lists each of the interface connectors on the camera and the mating connector for the cable. This table includes part numbers for these connectors.

## 6.0 POWER INPUT CONNECTOR

Power is applied to the camera through a three pin connector. Pin 1 is a 12 V dc input, pin 2 is ground. This connector is shown in figure 5.

## 7.0 VIDEO OUTPUT CONNECTORS

Both analog and digital video outputs are available from this camera.

Table 4. Camera Interface Connectors					
REF DESIG	CONNECTOR NAME	CAMERA CONNECTOR		MATING CABLE CONNECTOR	
		Cohu P/N	Mfg P/N	Cohu P/N	Mfg P/N
J1	Auxiliary	1310449-050	Amp 787096-1	1310450-050	787131-1
J30	Digital Video			1310450-150	787133-1
J43	BNC Analog Video A	1310242-001	Amp 227754-1	Standard BNC plug	Standard BNC plug
J44	BNC Analog Video B				
J45	Power, 12 Vdc	1310356-003	Switchcraft TB3M	1310356-103	Switchcraft TA3F
J51	Lens	1310418-004	Choumusen D4-151N-100	1310419-004	Choumusen E4-191J-100

**NOTES:**  
 1. Fastening this connector and backshell to a 50-pin cable requires special tooling. It should not be attempted in the field. A test /development cable is available with this connector attached to one end and the other end unterminated. Request Cohu cable ER3774.

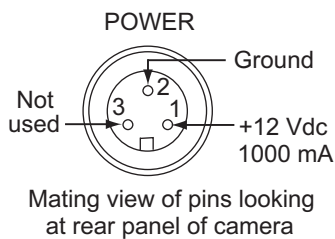
**7.1 ANALOG VIDEO OUTPUT**

The inboard BNC connector is the A-channel; the outboard BNC connector is B-channel video.

Progressive scan (single channel) mode video appears at the A-channel connector. No output appears at the B-channel connector when in this

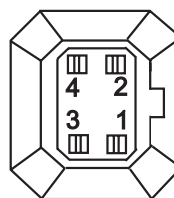
mode. See the camera rear panel view shown on figure 4.

When the camera is in the interlaced scan mode, video appears at both the BNC connectors. When the left connector provides odd/even fields the right connector simultaneously provides even/odd fields. A standard monitor can be connected to either connector



**Figure 5. Power connector**

Mating view of pins looking at side of camera



PIN	FUNCTION	
	Auto Iris	Dc Iris
1	+11.3	Damper Low
2	Lens Video	Damper High
3	Ground D	Iris Dc Voltage
4	Ground D	Ground D

**Figure 6. Lens Iris Connector**



for viewing the analog video output.

To provide a frame of video in 1/60 of a second, both BNC connectors must be connected to a two-channel frame grabber system that can combine the two channels.

## 7.2 DIGITAL VIDEO OUTPUT

A 10-bit Low Voltage Differential Signal (LVDS) output from a 50-pin rear panel connector provides jitter-free signal for demanding applications.

## 8.0 LENS CONNECTOR

See figure 6. This connector can be used with either auto iris lenses or dc iris lenses. The related switch below this connector establishes the proper pin functions for the type of lens being used. The **FUNCTION** table portion of this figure lists pin functions for the two switch selections.

## 9.0 AUXILIARY CONNECTOR

Of the 50 pins on this connector 13 are control inputs operating at TTL levels. Pin 17 is an analog gain control input, pin 18 is a balance control input, pin 24 is a TTL output for the pixel clock.

Two pins may be wired for remote gain control and remote channel balance.

Two pins may be used to provide horizontal and vertical trigger inputs for external sync modes.

Four pins provide horizontal drive output, vertical drive output, pixel clock output, and write enable outputs.

Table 2 and table 5 list pin functions for the auxiliary connector.

A separate publication (6X-1024) provides timing diagram relationships of various signals for the 6600-3000.

## 10.0 DIGITAL CONNECTOR

Table 6 lists the digital connector pin functions. Each output is provided in differential format. A plus (+) and a minus (-) pin is assigned to each function.

Digital video appears as two 10-bit differential outputs — identified as an A channel and a B channel.

A sync field identifier output is included as are outputs for vertical drive, horizontal drive, and the pixel clock.

## 11.0 EXTERNAL GAIN CONTROL INPUT

Manual control of gain from an external source requires connection of either a voltage source or a potentiometer to pin 17 of the auxiliary connector. Figure 7 illustrates this connection.

## 12.0 BALANCE CONTROL INPUT

Figure 8 illustrates two methods of connecting to this input. Pin 18 (table 2) on the auxiliary connector provides an input for externally controlling the relative gain between video channels A and B.

Figure 8 illustrates this connection. Note: Gain Control establishes channel A video level balance control. Adjust channel B gain to match channel A video level.

## 13.0 INTERNAL SWITCH SELECTIONS

Several functions can be controlled by DIP switch selections inside the camera on the main board (fig. 9). Table 7 lists these switches and provides a brief description of their functions.

Switch S1, accessible externally on the left side of the camera, selects whether the camera operates with manual gain control or automatic gain control (agc).

Switch S4, accessible externally on the right side of the camera, selects auto iris or dc iris functions

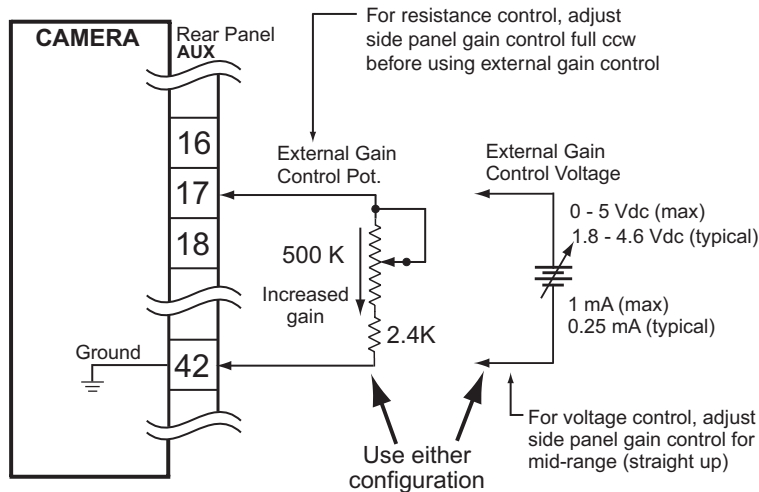


Figure 7. External Gain Control Circuits

for the lens iris connector mounted just above it.

DIP switch S3 controls sync functions and S2 controls shutter/integration timing selections. They are accessible only by removing the cover from the camera.

Table 8 provides a brief description of the camera operating modes.

Table 9 lists all the switch and auxiliary (Aux) connector signals required to control the camera.

Any sync function controlled through the Aux connector must have its respective internal switch in the open (**OFF**) position..

Table 10 lists the various shuttering and integration selections and gives the corresponding switch select position and auxiliary control input low/high state. If any of the internal switches is set to On (pulling a low state) the external control input on the auxiliary connector cannot then force that input high. Conversely, any external control line on the

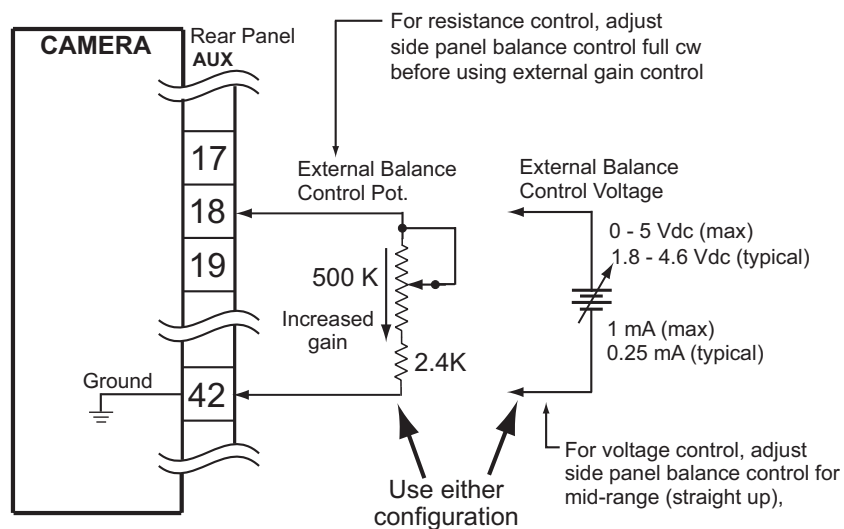


Figure 8. External Balance Control Circuits

Table 5. Auxiliary Connector Signal Descriptions				
INT SW	PINS	SIGNAL	LEVELS	DESCRIPTION
<b>Inputs</b>				
S2: 2,3,4	1, 2, 3	EDI 0, 1, 2	TTL	<b>Shutter / Integration control.</b> See table 10
S2: 5, 6	4, 5	SMD 1, 2	TTL	<b>Shutter / Integration control.</b> See table 10
S2: 1	6	EXT	TTL	<b>Sync Mode.</b> External sync (TTL high) lock to VT & HT Internal sync (TTL low) crystal operation
S3: 4	7	RM	TTL	<b>Video Mode.</b> Progressive scan (TTL low) single channel (30 fps) Interlaced (TTL high) dual channel (60 fps)
S3: 3	8	RDM	TTL	<b>Trigger Mode.</b> TTL low: Normal (continuous) TTL high: Asynchronous / Donpisha (snap shot)
S3: 2	9	RE VH	TTL	<b>Direct Reset Mode enable.</b> TTL high: enable direct reset - V or HV
S3: 1	10	RE ND	TTL	<b>Direct Reset Mode enable.</b> TTL low: Direct reset vertical TTL high: direct reset horiz & vert
	11	PLLEN	—	Reserved
	12	ARESET	TTL	<b>Asynchronous Reset.</b> Triggers on negative-going edge
	13	HTSG/	HIGH/LOW	<b>Integrate Enable.</b> Integrate when low. When HTSG/ goes high, outputs a single image on next vertical interval
	14	VT	TTL	<b>Vertical Trigger.</b> Used for external sync modes. Triggers on negative-going edge. Neg pulse 127 $\mu$ s minimum (2H period)
	15	HT	TTL	<b>Horizontal Trigger.</b> Used for external sync modes. Triggers on negative-going edge. neg pulse 0.3 $\mu$ s min
	17	REMGAIN	ANALOG	<b>Remote Gain.</b> External control of manual gain with voltage or resistance. Max gain = 0V or 2.4 k ohm. Min gain = 4.6V or 46 k ohm
	18	REMBAL	HIGH/LOW	<b>Remote Channel Balance.</b> External control with voltage or resistance. Max channel A (minimum channel B) = 0V or 0 ohm. Min channel A (maximum channel B) = 4.2V or 1 Megohm
	20	12 V dc + Input	Analog	Optional 12 V dc Input
	21			
	45			
	46			
		12 V dc Return	Analog	
<b>Outputs</b>				
	22	WEN/	TTL	<b>Write ENable (WEN) Pulse.</b> Goes low at start of video frame
	23	HDO	TTL	<b>Horizontal Drive Output</b>
	24	PIXCLK/	TTL	<b>Pixel Clock.</b> 12.272 MHz. Pixel aligned with negative edge
	25	VDO	TTL	<b>Vertical Drive Output</b>
<b>Reserved Functions</b>				
	16, 19, 41, 44	no connection	—	Reserved
Notes: Pins 26-43, & 47-50 are grounds (GNDD); INT SW column of table pertains to internal switches When using auxiliary connector to control camera modes, the corresponding internal switches (INT SW) must be in the high (OFF) positions.				

**Table 6. Digital Connector Descriptions**

Signal	In / Out	Description
DA[9:0] +/-	Output	Channel A Data bits 9 through 0. LVDS (Low Voltage Differential Signal) transmitters. RS-422 differential is available as an option. DA9 +/- is the most significant bit
DB[9:0] +/-	Output	Channel B Data bits 9 though 0. (Similar description to channel A)
SYNCFLD +/-	Output	May be hardware configured as either composite sync or field. Standard configuration is field
HD +/-	Output	Horizontal Sync
VD +/-	Output	Vertical Sync
CLK +/-	Output	Pixel Clock

*NOTES: All outputs are LVDS differential. Optionally, camera may be configured for RS-422. This uses more power and requires shorter cables (10 to 15 feet vs. 40 to 50 feet); however, RS-422 can drive TTL receivers in single-ended systems.*

Pin No.	Signal Name	Pin No.	Signal Name
1	DA9+ (MSB)	26	DA9- (MSB)
2	DA8+	27	DA8-
3	DA7+	28	DA7-
4	DA6+	29	DA6-
5	DA5+	30	DA5-
6	DA4+	31	DA4-
7	DA3+	32	DA3-
8	DA2+	33	DA2-
9	DA1+	34	DA1-
10	DA0+ (LSB)	35	DA0- (LSB)
11	DB9+ (MSB)	36	DB9- (MSB)
12	DB8+	37	DB8-

Pin No.	Signal Name	Pin No.	Signal Name
13	DB7+	38	DB7-
14	DB6+	39	DB6-
15	DB5+	40	DB5-
16	DB4+	41	DB4-
17	DB3+	42	DB3-
18	DB2+	43	DB2-
19	DB1+	44	DB1-
20	DB0+ (LSB)	45	DB0- (LSB)
21	SYNCFLD+	46	SYNCFLD-
22	HD+	47	HD-
23	VD+	48	VD-
24	GNDD	49	GNDD
25	CLK+	50	CLK-

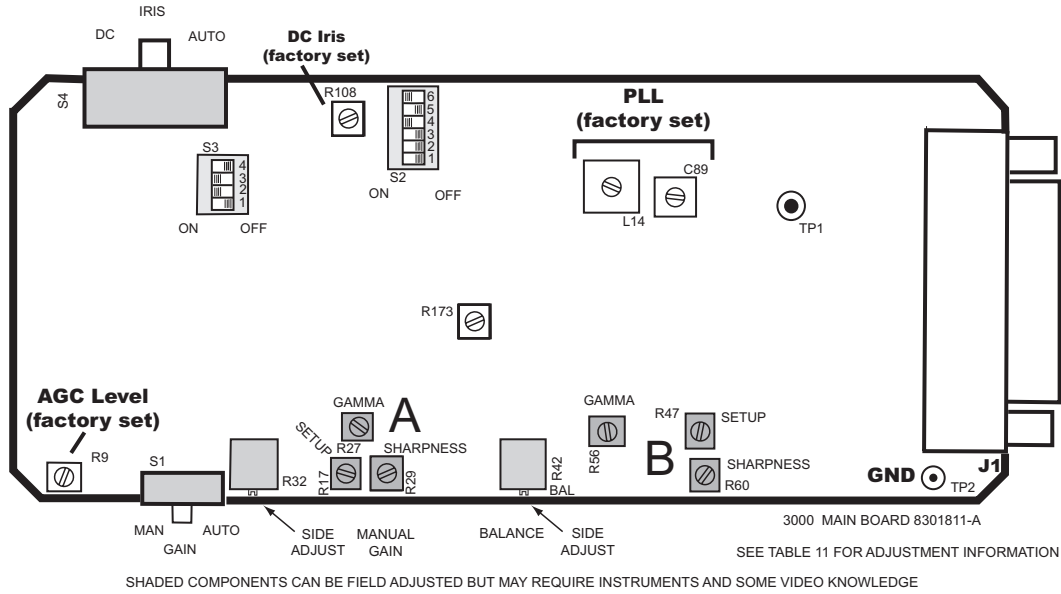


Figure 9. Adjustment Locations, Main Board

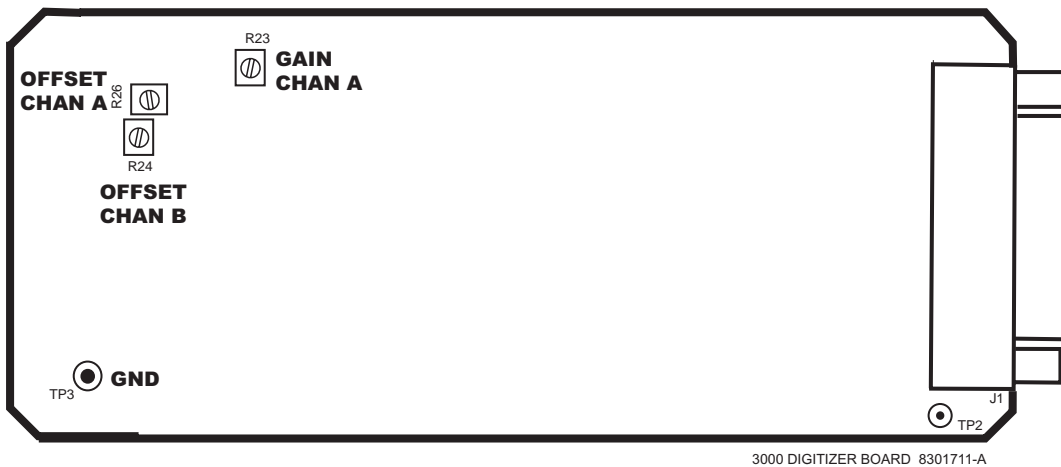


Figure 10. Adjustment Locations, Digitizer Board

auxiliary connector pulled low overrides any internal switch set to high.

**14.0 INTERNAL CONTROL POTENTIOMETERS**

Table 11 lists all the adjustments on the three boards. Several of these may require field adjustment due to installation or operational considerations. Most of the

controls require test bench setups and detailed step-by-step instructions and should not be changed.

On the main board (fig. 9) are potentiometers for setting A-channel gamma (R27) and setup (R17) level. Setup should be left at the industry standard 7.5 IRE units unless some special application mandates a different setting. An oscilloscope or waveform monitor is required to

Table 7. Internal Switch Selections			
REF DESIG	SIGNAL NAME	FUNCTION NAME	DESCRIPTION
MAIN BOARD			
S3-4	RM	1/30 or 1/60	Selects frame rate between [on] 1/30 (Non-interlaced) and [off] 1/60 (interlaced).
S3-3	RDM	Normal or asynchronous reset	Selects either normal or asynchronous reset. The asynchronous reset position activates pin 12 of the auxiliary connector. On is normal operation. Off is random trigger.
S3-2	REVH	V or HV reset	Selects either vertical or horizontal & vertical direct reset; activates pin 13 (V trigger) or pins 13 & 15 (H trigger) on the auxiliary connector. On is V reset. Off is HV reset.
S3-1	REND	Normal or direct reset	Selects either normal or direct reset mode. Direct reset allows the screen to go dark in the absence of sync while normal reset allows revert to crystal sync. On is normal reset. Off is direct reset.
S2-1	EXT	Internal or external sync	Selects internal or external sync source. On is internal sync. Off is external sync.
S2-4	EDI0	Shutter control	Selects either normal operation, shuttering speeds, or number of frames of integration. See table 10 for a list of various shuttering/integration selections.
S2-3	EDI1		
S2-2	EDI2		
S2-6	SMD1		
S2-5	SMD2		
S4	—	Auto/dc iris (side panel)	Selects between auto iris control or dc iris control at the side panel connector for the lens interface cable. Auto is to the rear.
S1	—	Agc on or manual	Selects whether camera has automatic gain control (agc) operation (cw) or manual gain (ccw)

*NOTE: When controlling camera modes remotely via the auxiliary connector, corresponding internal switches (see table 5) must be in the high (OFF) positions.*

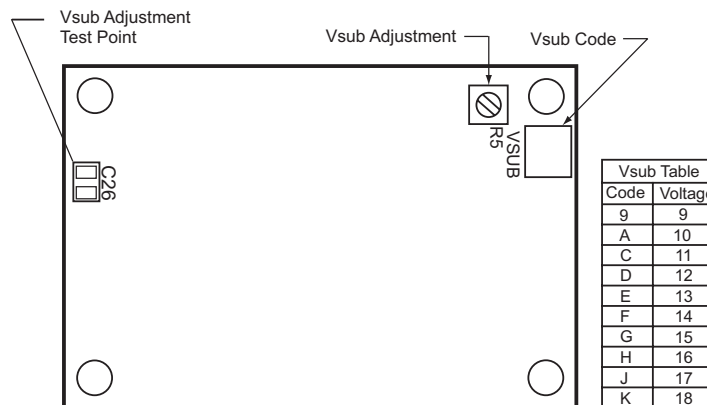


Figure 11. Adjustment Locations, Sensor Board

Table 8. Camera Modes		
ITEM	FUNCTION	DESCRIPTION
<b>OPERATING MODES</b>		
1	Continuous -Internal clock	Continuous (free running) operation using internal crystal. Supports all shuttering/integration modes. Operates in single- or dual -channel modes.
2	Continuous - H V lock	Continuous operation using internal PLL locked to horizontal sync. Supports all shutter/integration modes. Only operates in dual-channel mode.
3	Asynchronous reset (Donpisha)	Snap-shot operation. Outputs a single frame on negative edge of ARESET on the auxiliary connector. Operates in single- or dual-channel modes. In dual channel mode channel A always outputs odd field and channel B always outputs the even field. Does not output a vertical sync in the video frame. WEN/ on the auxiliary connector identifies the beginning of a video frame. WEN/ is ORed with VD to provide a virtual sync on the digital output.
4	Direct reset - vertical (direct reset)	Snap-shot operation. Outputs a single frame on negative edge of VT (vertical trigger) on the auxiliary connector. Operates in single- or dual-channel modes. Does not support internal shutter or integration. Operation is controlled with VT. Upon receiving VT, the sensor immediately dumps its charge and begins integrating. After a minimum of 1 frame time (60 fps in dual-channel, 30 fps in single-channel) a second VT needs to be applied to dump the captured image. Limited partial scan can be performed in this mode by making the interval between VT pulses than 1 frame time. As the frame rate increases the bottom and top of the image becomes corrupted, e.g., 50% faster corrupts one-half the image, 100% corrupts the full image. HT (horizontal trigger) may be used to steer the field output direction in dual channel mode. If no HT is provided, field output direction is arbitrary.
5	Direct reset - horizontal/vertical (direct reset)	Snap-shot operation. Outputs a single line for each negative edge of HT. Operates in single- or dual-channel modes. Does not support internal shutter / integration. VT and HT control shutter and field direction the same as in <b>Direct Reset - Vertical</b> mode.
<b>OUTPUT MODES</b>		
6	Single channel	30 frames a second from channel A
7	Dual channel	60 frames per second output through both channels (A and B). Each channel outputs an interlaced field (every other line of a frame) at a rate of 60 fields per second. Each channel simultaneously outputs the opposite field (one field with odd lines, the other with even lines) for a combined rate of 60 frames per second. During continuous operation, each channel continuously alternates between odd and even fields.
<i>Continued</i>		

Table 8. Camera Modes (continued)		
ITEM	FUNCTION	DESCRIPTION
<b>SHUTTER / INTEGRATION MODES</b>		
8	No shutter	Shutter integrates over the full vertical interval (1/30 second in single channel mode and 1/60 second in dual channel mode).
9	Flickerless	For use with European fluorescent lighting. A 1/120 second shutter guarantees exposure only to one fluorescent light cycle. Otherwise this mode may be used as just another shutter speed.
10	Programmable shutter	8 settings ranging from 1/60 to 1/10,000 second plus flickerless.
11	Programmable integration	8 settings ranging from 2 fields to 16 fields.
12	External integration	Integrates for the duration of HTSG/ (on the auxiliary connector)

adjust setup to a known level when the lens is capped.

Also on the main board (fig. 9) are four potentiometers for channel B. Gamma for the B-channel video is controlled by R56. Setup level for the B-channel video is controlled by R47.

Manual gain control can be selected by the side panel agc/manual select switch (S1). When set to the right the camera is placed in manual gain mode. The GAIN control (R32) to the right of this switch then establishes camera gain. This pot controls gain for both channels when the camera is in manual gain mode. Maximum gain is cw.

Channel B has a balance potentiometer associated with it (R42). In the interlaced mode it provides equal video level for the odd and even fields.

Adjustments are also available on the digitizer board (fig. 10) and on the sensor board (fig. 11).

## 15.0 OPERATING MODES

See table 8 for a summary of operating modes. See tables 9 and 10 for mode switch and control settings.



TABLE 9

6600 PROGRESSIVE SCAN CAMERA MODEL 3000 (DIGITAL) MODE & CONTROL CONFIGURATION

Mode #	Sync Modes	MODE SELECT SIGNALS													CONTROL SIGNALS				
		EXT Int / Ext Sync	ED12 Shutter Speed	ED11 Shutter Speed	ED10 Shutter Speed	SMD2 Shutter Mode	SMD1 Shutter Mode	REND Normal / Direct Ext-Rst	REHV V or HV Direct Reset	RDM Norm / Async Trigger	IRM Interface or Prog - Scan	ARES Async Reset	HTSGI Integrate Enable	VT Vertical Trigger	HT Horiz Trigger				
	Internal Sync (Crystal Operation)	J1-6	J1-3	J1-2	J1-1	J1-5	J1-4	J1-10	J1-9	J1-8	J1-7	J1-13	J1-14	J1-15					
	Dual Channel Operation (Interfaced)	M:S2-1	M:S2-2	M:S2-3	M:S2-4	M:S2-5	M:S2-6	M:S3-1	M:S3-2	M:S3-3	M:S3-4								
1	Continuous – Internal Clock (Normal Trig)	Lo / On	x	x	x	Hi / Off	Hi / Off	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
2	No Shutter	Lo / On	x	x	x	Lo / On	Lo / On	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
3	Flickerless Shutter (1/100 Sec)	Lo / On	table 2	table 2	table 2	Hi / Off	Lo / On	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
4	Programmable Shutter	Lo / On	table 2	table 2	table 2	Hi / Off	Lo / On	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
5	Programmable Integration (Fixed Intervals)	Lo / On	table 2	table 2	table 2	Hi / Off	Lo / On	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
6	External Integration (HTSG)	Lo / On	x	x	x	Hi / Off	Hi / Off	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
7	External Integration (HTSG)	Lo / On	x	x	x	Hi / Off	Hi / Off	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
8	Async Reset – Donpisha (Single Shot) (No V-Sync)	Lo / On	x	x	x	Lo / On	Lo / On	x	x	Hi / Off	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
9	Flickerless Shutter (1/100 Sec)	Lo / On	table 2	table 2	table 2	Hi / Off	Lo / On	x	x	Hi / Off	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
10	Programmable Shutter	Lo / On	table 2	table 2	table 2	Hi / Off	Lo / On	x	x	Hi / Off	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
11	Programmable Integration (Fixed Intervals)	Lo / On	table 2	table 2	table 2	Hi / Off	Lo / On	x	x	Hi / Off	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
12	External Integration (HTSG)	Lo / On	x	x	x	Hi / Off	Hi / Off	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
13	Async Reset – Donpisha (Single Shot) (No V-Sync)	Lo / On	x	x	x	Lo / On	Lo / On	x	x	Hi / Off	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
14	Flickerless Shutter (1/100 Sec)	Lo / On	table 2	table 2	table 2	Hi / Off	Lo / On	x	x	Hi / Off	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
15	Programmable Shutter	Lo / On	table 2	table 2	table 2	Hi / Off	Lo / On	x	x	Hi / Off	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
16	Programmable Integration (Fixed Intervals)	Lo / On	table 2	table 2	table 2	Hi / Off	Lo / On	x	x	Hi / Off	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
17	External Integration (HTSG)	Lo / On	x	x	x	Hi / Off	Hi / Off	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
18	Async Reset – V or HV (disabled in Sync Loop Back)	Lo / On	x	x	x	Hi / Off	Hi / Off	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
19	Vertical (1 Fld per V Sync) (*2)	Lo / On	x	x	x	Hi / Off	Hi / Off	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
20	Horizontal (1 Line per H Sync)	Lo / On	x	x	x	Hi / Off	Hi / Off	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
21	Single Channel Operation (Prog Scan)																		
22	Direct Reset – V or HV (disabled in Sync Loop Back)	Hi / Off	x	x	x	Hi / Off	Hi / Off	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
23	Vertical (1 Frame per V Sync)	Hi / Off	x	x	x	Hi / Off	Hi / Off	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					
24	Horizontal & Vert (1 Line per H Sync)	Hi / Off	x	x	x	Hi / Off	Hi / Off	Lo / On	Lo / On	Lo / On	Hi / Off	Hi / Open	Hi / Open	Hi / Open					

\*1: Sync Loop Back mode is a hardwired option which allows "External Sync - Dual Channel" Operation to output continuous odd frames (odd field Ch A, Even field Ch B). This configuration does not require any external sync and disables HV Lock and all Direct Reset Modes. If configured for HV Lock, camera requires VT & optionally HT (HT automatically enables PLL, otherwise reverts to crystal). If using HT, camera requires RS-170 quality VT & HT.

\*2: HT may be used to steer output field direction. Else, field direction is arbitrary.

Programmable Function	Shutter / Integration Control Signals (Aux Pins / Switches)			Shutter Speed	
	ED10 (M:S2-4)	ED11 (M:S2-3)	ED12 (M:S2-2)		
Shuttering	low/on	low/on	low/on	1/10,000 s (100 µs)	
	high/off	low/on	low/on	1/4,000 s (250 µs)	
	low/on	high/off	low/on	1/2,000 s (500 µs)	
	high/off	high/off	low/on	1/1,000 s (1 ms)	
	low/on	low/on	high/off	1/500 s (2 ms)	
	high/off	low/on	high/off	1/250 s (4 ms)	
	low/on	high/off	high/off	1/125 s (8 ms)	
	high/off	high/off	high/off	1/60 s (16 ms)	
	Integration	low/on	low/on	low/on	16 fields (8/30 sec)
		high/off	low/on	low/on	14 fields (7/30 sec)
low/on		high/off	low/on	12 fields (6/30 sec)	
high/off		high/off	low/on	10 fields (5/30 sec)	
low/on		low/on	high/off	8 fields (4/30 sec)	
high/off		low/on	high/off	6 fields (3/30 sec)	
low/on		high/off	high/off	4 fields (2/30 sec)	
high/off		high/off	high/off	2 fields (1/30 sec)	

**Shutter / Integration Mode Settings**

**CONFIGURATION MODE SWITCHES**

- M:S1 Gain Select (Manual / AGC). Right = Manual Gain (Set w/ M:R32), Left = AGC.
- M:S2 Mode Control switches. See tables.
- M:S3 Mode Control switches. See tables.
- M:S4 Auto Iris / DC Iris Select. Towards camera front = Auto Iris, Towards camera rear = DC Iris.
- D:S1-1,2,3,4 Not used.

**CONFIGURATION POTS, CAPS, COILS & TEST POINTS**

- M:R32 Gain Pot. CW = max, CCW = min.
- M:R42 Gain Balance.
- M:R9 AGC Level. Factory set.
- M:R17 Setup (Black Level) Ch A. Factory set to 0.7 IRE.
- M:R47 Setup (Black Level) Ch B. Factory set to 0.7 IRE.
- M:R27 Gamma Ch A. CCW = min (1), CW = max (0.45).
- M:R56 Gamma Ch B. CCW = min (1), CW = max (0.45).
- M:R29 Sharpness Ch A. CCW = Disable, CW = Enable.
- M:R60 Sharpness Ch B. CCW = Disable, CW = Enable.
- M:R108 Auto Iris / DC Iris level set. Set to match Lens.
- M:L14 PLL tuning. Factory set.
- M:C89 PLL tuning. Factory set.
- M:TP1 Test Point - External Sync Oscillator.
- M:TP2 Test Point - Power Supply Ground.
- D:TP3 Test Point - Power Supply Ground.
- D:TP1,2 Not Used (not installed)
- D:R163 Not Used (not installed)

**LEGEND**

- Mode select signals are controlled through either the Aux Connector J1 or internal switches S2 & S3. Signals with associated connector pins (J1-n) & switches (S2-n or S3-n) are shown in the tables. When using Aux connector, all associated switches must be in the open position.
- Mode #1 is the default mode (as shipped).
- M: & D: designate Main board (bottom board) & Digitizer board (top board).
- S = switch, R = variable resistor, L = variable coil, C = variable cap.

<b>Table 11. Camera Adjustments and Settings</b>		
<b>REF DESIG</b>	<b>NAME</b>	<b>FUNCTION</b>
<b>MAIN BOARD</b>		
C89	PLL capacitor	Adjusts phase locked loop (factory set)
L14	PLL inductor	
S1	MAN/AUTO GAIN	Selects manual or automatic gain control (agc)
S2	Shutter/Integrate	Sets sensor for various shuttering and integrating timings
S3	SYNC MODE	Selects desired sync operating mode
S4	DC/AUTO IRIS	Selects either dc or auto iris operation for lens
R9	AGC LEVEL	Sets operating point of agc circuit (factory adj)
R17	SETUP A	Sets black level reference (pedestal) of A channel
R27	GAMMA A	Sets amount of gamma in A channel
R29	SHARPNESS A	Sets amount of edge enhancement available in channel A
R32	MANUAL GAIN	Sets gain of A channel in manual mode
R42	BAL	Sets gain of B channel in manual mode to equal that of A channel
R47	SETUP B	Sets black level reference (pedestal) of B channel
R56	GAMMA B	Sets amount of gamma in B channel
R60	SHARPNESS B	Sets amount of edge enhancement in channel B
R108	DC Iris	Sets operating point of dc iris output control voltage
R173	BAL AMP GAIN	Sets operating point for BAL adjust R42
TP1	PLL test point	Measuring point for PLL charge pump voltage
TP2	GND	Ground
<b>DIGITIZER BOARD</b>		
R23	GAIN CHAN A	Sets channel A gain to that of Channel B
R24	OFFSET CHAN B	Sets offset voltage to channel B A/D converter
R26	OFFSET CHAN A	Sets offset voltage to channel A A/D converter
TP3	Ground	
<b>SENSOR BOARD</b>		
R5	Vsub Adjustment	Sets substrate voltage to required level for that sensor

<b>Table10. Shuttering / Integration Mode Settings</b>				
<b>FUNCTION</b>	<b>Shutter / Integration Control Signals (Aux Pins / Switches)</b>			
	<b>EDIO (S2-4)</b>	<b>EDI1 (S2-3)</b>	<b>EDI2 (S2-2)</b>	<b>Shutter Speed</b>
<b>Shuttering</b>	LOW / ON	LOW / ON	LOW / ON	1/10,000 s
	HIGH / OFF	LOW / ON	LOW / ON	1/4,000 s
	LOW / ON	HIGH / OFF	LOW / ON	1/2,000 s
	HIGH / OFF	HIGH / OFF	LOW / ON	1/1,000 s
	LOW / ON	LOW / ON	HIGH / OFF	1/500 s
	HIGH / OFF	LOW / ON	HIGH / OFF	1/250 s
	LOW / ON	HIGH / OFF	HIGH / OFF	1/125 s
	HIGH / OFF	HIGH / OFF	HIGH / OFF	1/60 s
<b>Integration</b>	LOW / ON	LOW / ON	LOW / ON	16 fields (8/30s)
	HIGH / OFF	LOW / ON	LOW / ON	14 fields (7/30s)
	LOW / ON	HIGH / OFF	LOW / ON	12 fields (6/30s)
	HIGH / OFF	HIGH / OFF	LOW / ON	10 fields (5/30s)
	LOW / ON	LOW / ON	HIGH / OFF	8 fields (4/30s)
	HIGH / OFF	LOW / ON	HIGH / OFF	6 fields (3/30s)
	LOW / ON	HIGH / OFF	HIGH / OFF	4 fields (2/30s)
	HIGH / OFF	HIGH / OFF	HIGH / OFF	2 fields (1/30s)
<i>Notes: S2 is on the main board.</i>				