ANALOG CCD TV CAMERA - 8

NICAL S.P.A.

CCD CAMERA
N23

TV CAMERA FOR USE WITH
X-RAY IMAGE INTENSIFIER

Service Manual

October 2004 Release 1

SUMMARY

1. INTRODUCTION

The CCD camera N23 system acquires and digitizes radiological images.
This equipment must be used in accordance with the manual and is not intended for any use outside of that herein described.
The N23 is a device component and interfaces to x-ray equipment and as such must be used by qualified personnel only with knowledge of all x-ray protection.
The user is also responsible for all additional compliance certification and correct function at time of installation.

2. SAFETY INSTRUCTIONS

NICAL S.p.A. accepts no responsibility for any misuse of the CCD camera N23 outside of its original design and description as set forth in manual.
Furthermore NICAL S.p.A accepts no responsibility for any damages to camera, operator, and patient, due to incorrect installation or unauthorized modification (mechanical or electrical) and misuse of N23 CCD system.

Only personnel authorized by NICAL S.p.A may service equipment.
Authorized persons may only remove covers when servicing electrical power concerns.
It is mandatory to replace parts with only original NICAL S.p.A. replacement components.

2.1. Warnings

1. Read these instructions carefully. Save these instructions for future reference.
2. Follow all warnings and instructions marked on the product.
3. Slots and openings in the cabinet are provided for ventilation; to ensure reliable operation of the product and to protect it from overheating, these openings must not be blocked or covered.
4. This product should be operated from the type of power indicated on the marking label. If you are not sure of the type of power available, consult NICAL Company.
5. When the CCD camera is turned on make a white test in according to verify the quality image.

2.2. Environmental risks and disposal

The CCD CAMERA N23 contains some materials that can be recycled at the end of its life cycle.
In particular the system contains the following materials:

- Iron, copper, lead, aluminium, non-biodegradable plastics, and fiber of glass printed circuit boards.

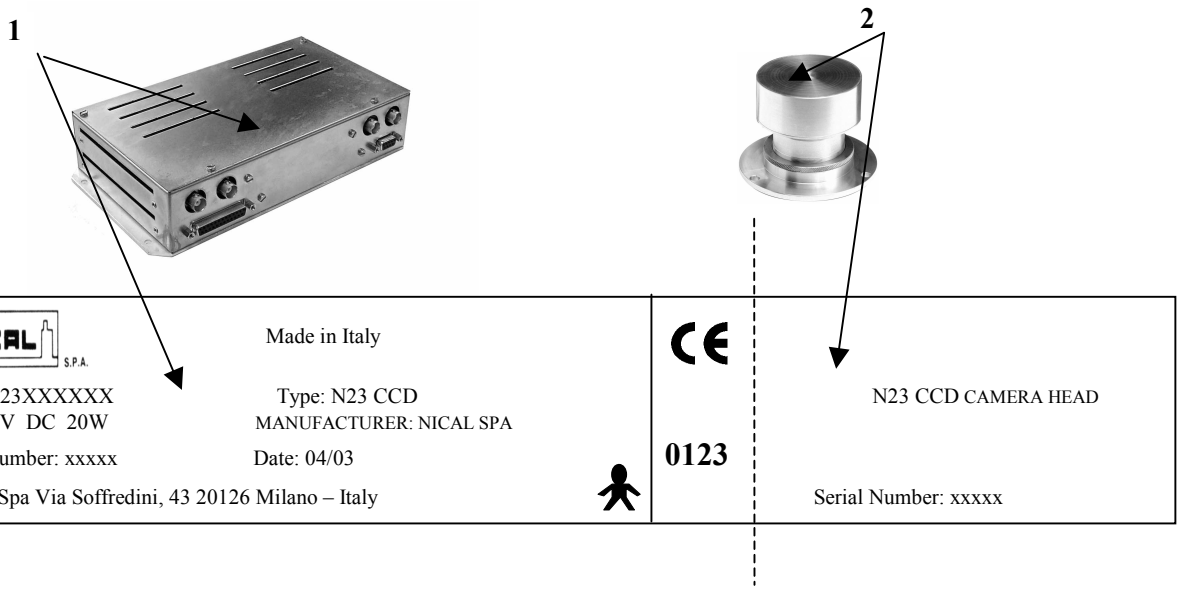
NICAL S.p.A. does not accept equipment for recycling.

2.3. Symbols

Symbol	Description
	Attention, consult the documentation
DC	Direct current
	Compliance to Medical Device directive:93/42
	Device with type B parts
	Protective earth (ground)

3. DESCRIPTION

3.1. Identification labels



3.2. Description

MAIN DIGITAL BOARD			PROCESSING BOARD	MEMORY BOARD
N23	50	N	I	0	1

50 CCIR 625/50
60 EIA 525/60

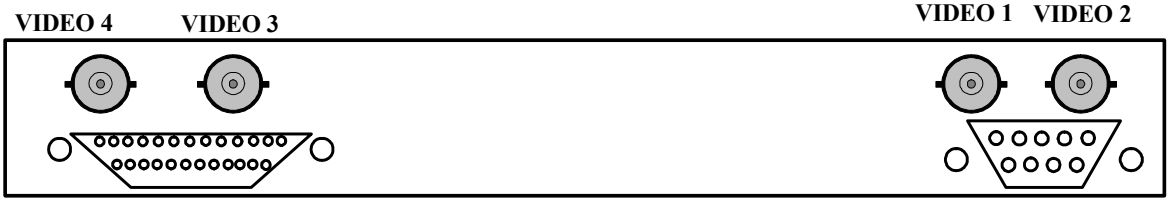
N Normal
R Rotation

A Main analog board only
I Digital + H/V Inversion + recursive filter
H Digital + H/V Inversion + DRF(Dynamic recursive filter).

A 0 Frames
1 32 Frames
2 256 Frames
4 512 Frames

	Video 1	Video 2	Video 3 - Video 4
N	525 / 625	---	---
0	525 / 625	525 / 625	---
1	525 / 625	525 / 625	525 / 625
2	525 / 625	525 / 625	1049 / 1249
3	625 50Hz 525 60Hz	625 50Hz 525 60Hz	625 100Hz 525 120Hz

Video 1 from main analogic board
Video 2 / 3 / 4: LIH & recursive filter & memory if present



CABLE
CONTROL + PWR CABLE
(Female DB25)

CABLE
CAMERA HEAD CABLE
(female DB9)

4. TECHNICAL DATA & CERTIFICATIONS

Available CCD scanning system :	
	CCIR 625/50 interlaced (752 x 582 pixels) EIA 525/60 interlaced (768 x 494 pixels)
Scanning aspect ratio:	4:3
CCD Camera Head :	
CCD Type:	½" Interline low blooming CCD sensor (470.000 pixels)
Integrated optical lens system:	High resolution with adjustable focus and diaphragms
Image intensifier output screen:	From 15 to 40mm diameter.
Mounting frames:	From 6" inch to 16" inch I.I.
CCD / CCU Characteristics :	
Resolution:	20 lines-pairs (on 6" image intensifiers)
Gamma correction:	0.4 or 1
Video output A/D converter:	10 bits
Video Bandwidth:	20 MHz ± 3dB
DRF (Dynamic Recursive Filter):	Yes (N23H)
MD (Motion Detection):	Yes (N23)
Standard Recursive filter:	Factor 2,4,8,16
Memory:	16 bits
Automatic video level compensation:	Yes
Automatic x-ray kV/mA compensation:	Yes. Analog and digital (up/down)
Dynamic contrast compensation for better image uniformity:	Yes (shading)
Very high dynamic video amplifier:	Yes
High precision electronic circle:	Yes
Video output signal:	1 Vpp (0.3 Vpp Sync)
Video output standards :	
Analog Main board (Video 1):	1 BNC 75Ω - (CCIR 625/50 or EIA 525/60)
Digital Main board (Video 2) recursive filter and/or DRF & LIH & frame stored:	1 BNC 75Ω - (CCIR 625/50 or EIA 525/60)
Digital processing board (Video 3) (Video 4):	2 BNC 75Ω CCIR 625/50 interlaced EIA 525/60 interlaced CCIR 1249/50 interlaced EIA 1049/60 interlaced CCIR 625/100Hz interlaced EIA 525/120Hz interlaced
Operating conditions :	
Working temperature range:	-10°C to +45°C
Store temperature range:	-40°C to +55°C
Humidity:	Operating to 95% relative humidity (non-condensing)
Mechanical specifications :	
Control unit: dimension (WxDxH)/ Weight:	226 x 120 x 46mm 0,550 Kg
Camera head: dimension (ϕ x H)/Weight:	(Standard) 85x87mm 0,460 Kg (with Rotation) 101x87mm 1,1 Kg
Available power supply :	24Vdc ± 20%
Approvals :	
Safety:	EN 60601-1
EMC:	EN 60601-1-2
Others:	CE-label according 93/42 CEE directive for medical devices.
Options :	360° Continuous rotating camera head (with slip ring) C-Mount Zoom lens Neutral density filter: 25% or 50% light transmission

5. MAINTENANCE AND CLEANING

5.1. Maintenance

The system will serve you well if you take care of it.

- Do not spill liquids on the system.
- Do not subject the system to heavy shock and vibration.
- Never place objects on top of the system to avoid damaging it.
- All electrical equipment should be used according to the instruction provided. It is advised to control all connections and the image quality on a regular basis. It will guarantee an efficient function and long product life.

Maintenance guide

Frequency	Description
2 years	Cable connection and condition inspection
1 year	Image quality check

5.2. Cleaning

When cleaning the system, follow these steps:

- Power off the system.
- Use a soft cloth moistened with water.
- Do not use liquid or solvents.

6. CCD CAMERA N23 DESCRIPTION

The N23 CCD camera, manufactured using printed circuit board with SMD technology, offers better performance than NICAL' s well know N20 camera system. It uses the same camera head of CCD camera N20 and the same wiring and controls. All previously offered configurations are available in the new system along with vertical-horizontal inversion and continuous 360° rotation. Digital integrated image processing has been changed from 9 to 10 bit output resolution for better performance. This new system allows obtaining 512 frames memory with icons and numbered frames displayed. These new characteristics put the new N23 CCD at the top of the standard resolution CCD cameras for x-ray image intensifier and radiological applications.

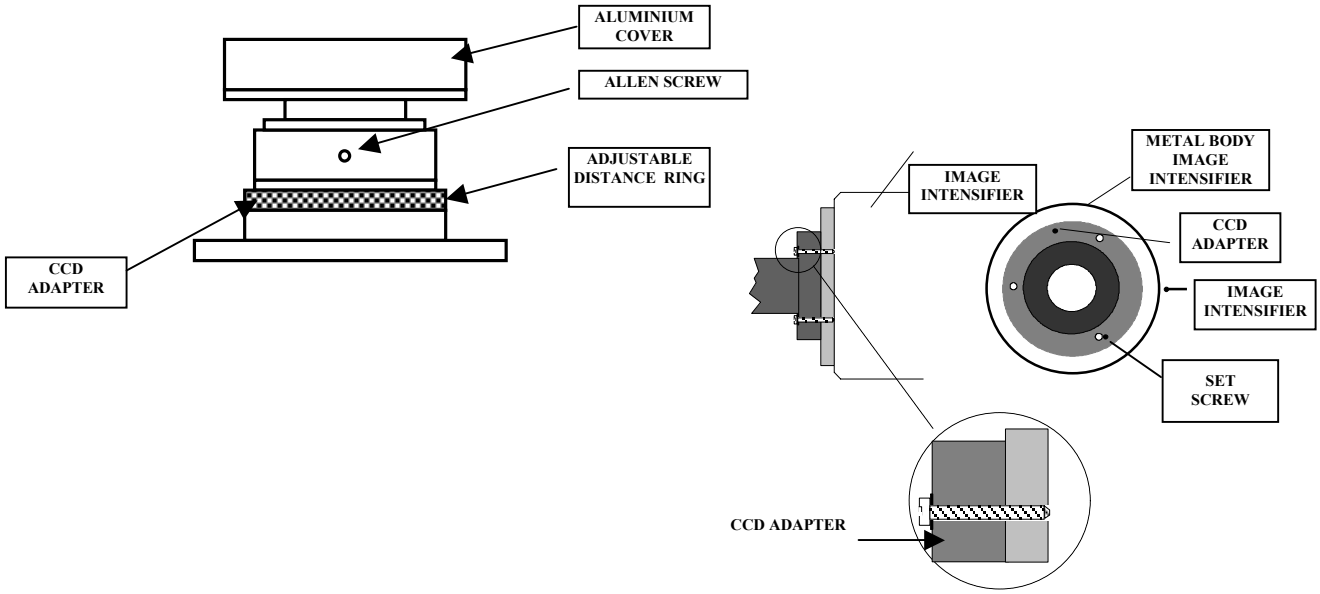
A very important new feature available on N23H is DRF (Dynamic Recursive Filter) which allows changing pixel by pixel the recursive filter factor. This type of filter offers better photonic noise reduction, eliminating also image persistence during patient moving.

7. COMPONENT POSITIONS

7.1. POSITIONING OF CAMERA HEAD

Place camera head into output phosphor well of image intensifier (see figure below).
Line up holes at 120' and fasten with screws to intensifier. If necessary it is possible rotate camera head 90° by 90° with screws at the bottom of the cover head.

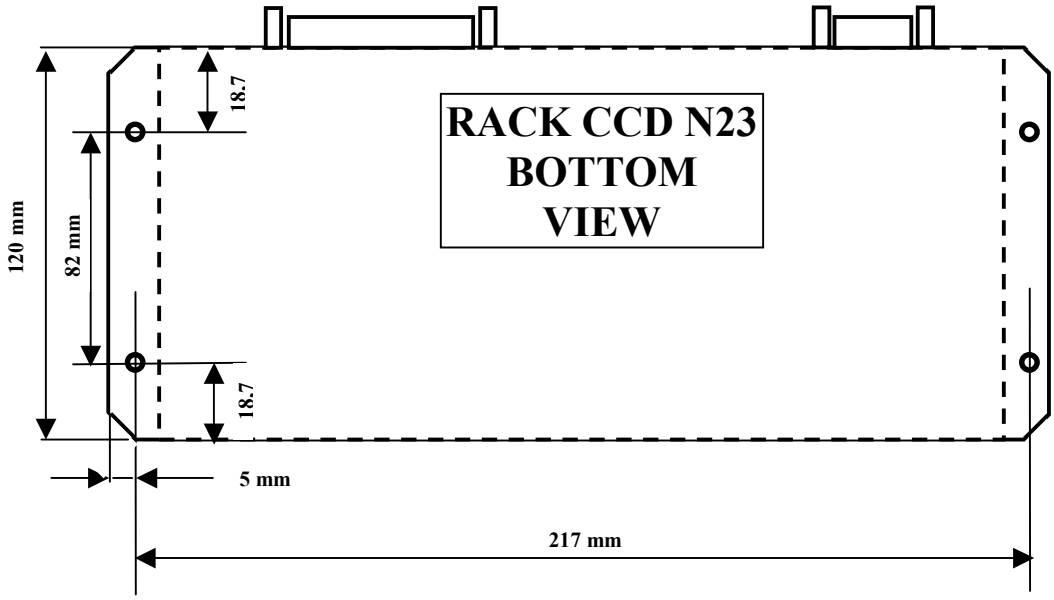
NOTE: For best performance it's better to **insulate the camera head from the ground system**. For this reason the camera head has a special superficial treatment to insulate the head when it is fixed with screws to the system. Be sure to use plastic insulation with screw to fix head at the system.



7.2. POSITIONING OF CCU

Line up holes at the bottom of the cover CCU and fasten with screws to the system.

NICAL COMPANY DOES NOT PROVIDE THE SET SCREWS



8. STANDARD INSTALLATION

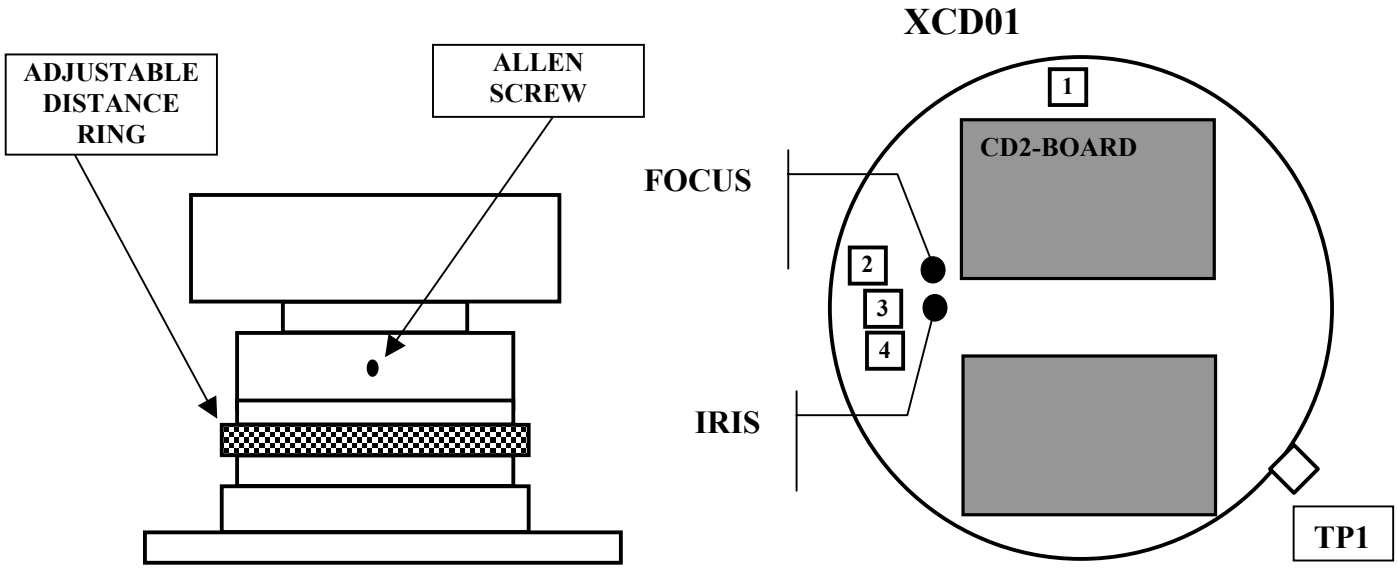
All the CCD cameras are calibrated in Nical Company and the customer may regulate the following functions only:

1. DISTANCE (IMAGE DIMENSION)
2. FOCUS OF THE CCD CAMERA HEAD
3. IRIS OF THE CCD CAMERA HEAD
4. SHADING REGULATION

The parts where it is possible to find these regulations are:

1-2-3 CCD CAMERA HEAD
4 N23_ANB1 BOARD

8.1. Camera Head (CCD head adjustments)



DISTANCE (IMAGE DIMENSION) SET TO REQUIRED PICTURE DIMENSION.
UNLOCK THE ALLEN SCREW, ADJUSTABLE DISTANCE RING AND ROTATE THE INTERNAL CYLINDER UNTIL THE REQUESTED DISTANCE.

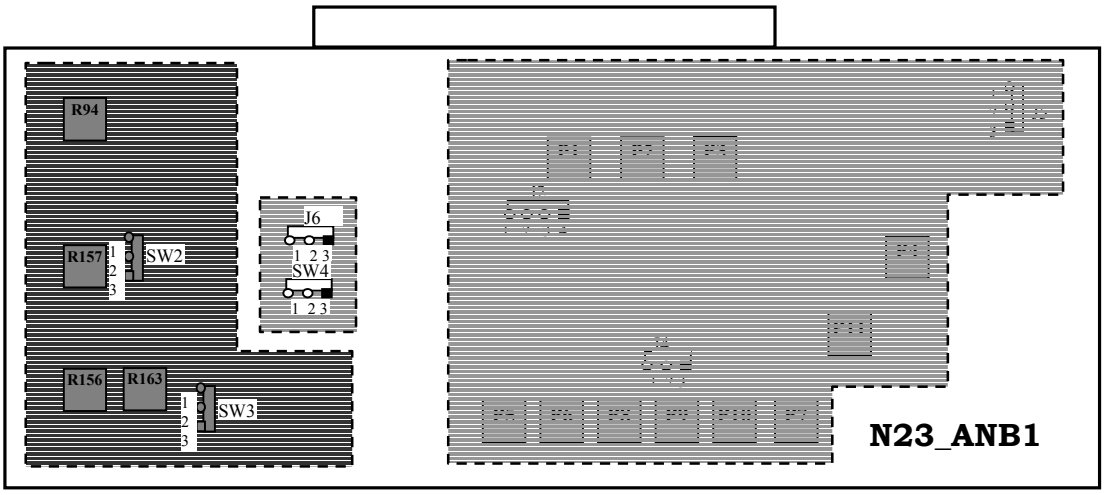
FOCUS SET FOR BEST FOCUS BETWEEN IMAGE INTENSIFIER AND CAMERA HEAD

DIAPHRAGM WITH STANDARD DOSE REQUESTED, SET SCREW OF IRIS UNTIL THE 2 LEDS ON N23_ANB1 TURN OFF. (In these conditions the value of video signal is equal to 1,3V at test point (TP1)

8.2. CCU adjustment

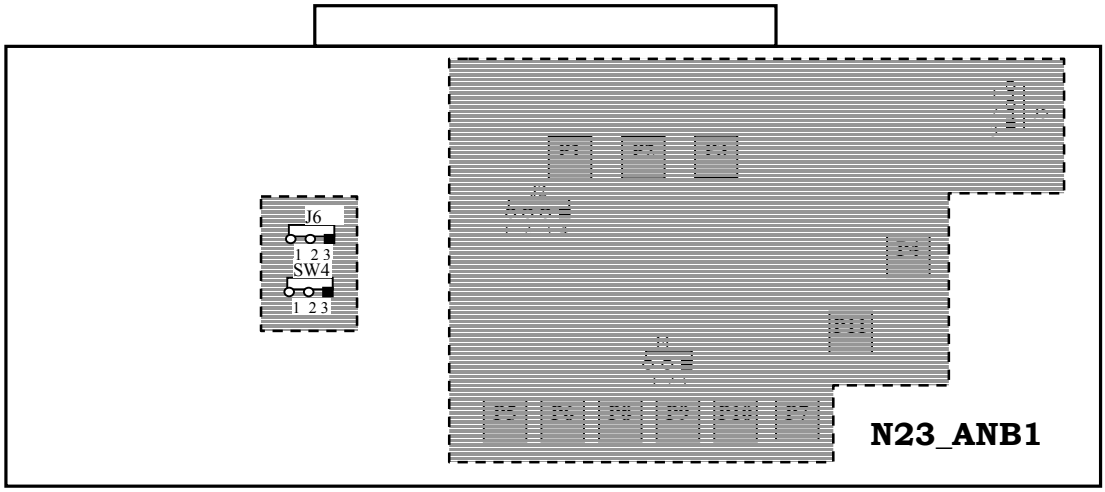
SHADING MOVE JUMPER J4 (SHADING) ON N23_ANB1 BOARD FROM POSITION 1-2 (OFF) TO POSITION 2-3 (ON), AND ADJUST P7, P8, P9, P10 FOR BEST IMAGE UNIFORMITY (using flat x-ray image at standard dose).

8.3. Set up points



CODE	NAME	DESCRIPTION
SW2	**AUTO BLK**	It is used to enable the Black Level Auto Control. (SW2 ON: position 1-2)
R157	**BLACK LEVEL**	Ad just black level pedestal (BOTTOM BLACK). When Auto BLK off (SW2 OFF: position 2-3) regulate the pedestal to 30mV respect referring level
R156	**BLACK LEVEL AUTO CONTROL**	Ad just black level pedestal (BOTTOM BLACK). When Auto BLK on (SW2 ON: position 1-2) regulate the pedestal to 30 mV respect referring level.
SW3	**AUTO WTH**	It is used to enable the Auto White Level. (SW3 ON: position 1-2)
R163	**AUTO WHITE LEVEL**	Ad just white level (TOP WHITE). Set to 590mV video analog signal respect referring level. Use jumper SW3=ON (position 1-2) to select or reject this feature.
R94	**GAMMA**	Factory adjusted
SW4	**ANALOG VIDEO (2-3) /SYNC PULSE PER SCOPIA PULSATA (1-2)**	It is used to enable on Video 1 an analogic signal: (position 2-3) or an output at 25Hz/30Hz square wave (position 1-2) used as sync pulse in high contrast
J6	**GAMMA CORRECTION**	Jumper J6 position 1-2: gamma value is 0, 4. Jumper J6 position 2-3: gamma value is 1
J4	**SHADING ENABLE**	It is used to enable shading regulations
P7-P8-P9-P10	**SHADING (VS-VP-HS-HP)**	Set the shading gain to compensate picture not uniformity because of Image Intensifier. Use jumper J4=ON (position 2-3) to select or reject this feature
J2	**VIDEO & AUTO CIRCLE ENABLE**	It is used to enable the video and auto video regulations J2 position 3-4: VIDEO CIRCLE; J2 position 2-3 AUTO CIRCLE
P6	**VIDEO CIRCLE**	Adjust circle blanking diameter. Use jumper J2=ON (position 3-4) to select or reject this feature
P5	**AUTO CIRCLE**	Adjust measurement circle area used by automatic gain and x-ray KV control. Use jumper J2=ON (position 2-3) to select or reject this feature
P3	**CIRCLE SIMMETRY**	Adjust the symmetry of video circle. Use jumper J2=ON (position 3-4) to select or reject this feature
P1	**VERT SHIFT**	Adjust the vertical centering of video circle. Use jumper J2=ON (position 3-4) to select or reject this feature
P2	**HOR SHIFT**	Adjust the horizontal centering of video circle. Use jumper J2=ON (position 3-4) to select or reject this feature
P4	**AUTO KV LEVEL**	Set the value of AUTO KV
P11	**AUTO KV WINDOW**	Increase or decrease the sensibility of the automatic KV control. This feature is very useful in according to adapt the CCD camera N23 for any kind of X-ray generator
J5	**ROTATION RESET (CCD CAMERA WITH ROTATION ONLY)**	**Position 2-3**: Automatic reset when system turned -on. **Position 1-2**: Manual reset. To bring camera head to 0 position ground pins CW (pin 17) and CCW (pin 4) on interface connector DB25 at the same time. Location: N23- MB0.

8.4. Customer Set up



SHADING

Using correct dose uniformity, regulate the trimmers P7, P8, P9 e P10 until to obtain on the monitor the maximum uniformity.
The jumper J4 enables or rejects this regulation.

KV AUTO

It is possible to change the answer sensibility of control system dose. In according to change the sensibility, use trimmer P11. The trimmer P4 changes the action point of the control (video level).

CIRCLE

Using trimmer P6 it is possible to change the diameter of video circle. The trimmer P5 regulates the circle area where it finds the dose automatic control (ROI). In according to select the video or the auto circle move the jumper J2. The trimmers P1, P2 and P3 regulate the centering and the symmetry.

GAMMA CORRECTION

It is possible change the gamma value. Moving jumper J6 in position 1-2 the gamma level corresponds to 0, 4; while moving jumper J6 in position 2-3 the gamma level is equal to 1.

VIDEO 1 OUTPUT

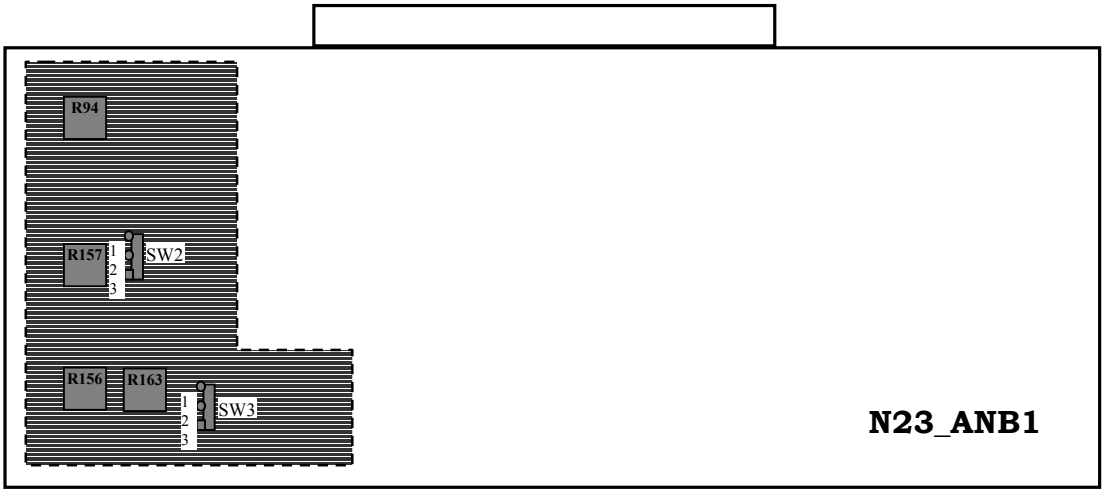
On BNC VIDEO 1 are possible changing two signals:
Analogic video 1Vpp 75Ω or a square wave signal 5Vpp at 25Hz/30Hz in according to sync x-ray systems in pulsed fluoroscopy.
To obtain the analogic video move jumper SW4 in position 2-3; while to obtain the square wave signal move jumper SW4 in position 1-2.

ROTATION

In the systems where the CCD camera head has the rotation:

1. Manual reset. (Factory default). Jumper J5 position 1-2. To bring camera head to 0 position ground pins CW (pin 17) and CCW (pin 4) on interface connector DB25 at the same time.
2. Automatic reset when system turned on. Jumper J5 position 2-3.

8.5. Factory set up only



VIDEO AUTO LEVEL

The system includes an automatic control of white (WH) and of black (BK).
The trimmer R157 regulates the level of black SET UP when there is not the image. Set up this trimmer in according to obtain a black-level of 20÷30mV.
The trimmer R156 reduces in automatic way the black-level to compensate the diffusion radiation. Using a phantom which simulates human body, regulate this trimmer until to obtain a good black-level when it presents diffusion radiation. It is possible reject this automatic control moving the jumper SW2 (position 1-2: on; position 2-3: OFF).
The trimmer R163 regulates the level of white automatic control (WH). Using a standard phantom and with white automatic control on regulate this trimmer until to obtain a correct video signal. It is possible reject this control by jumper SW3 (position 2-3) and also by the command AUTO-OFF (pin 2 25DB connector).

GAMMA

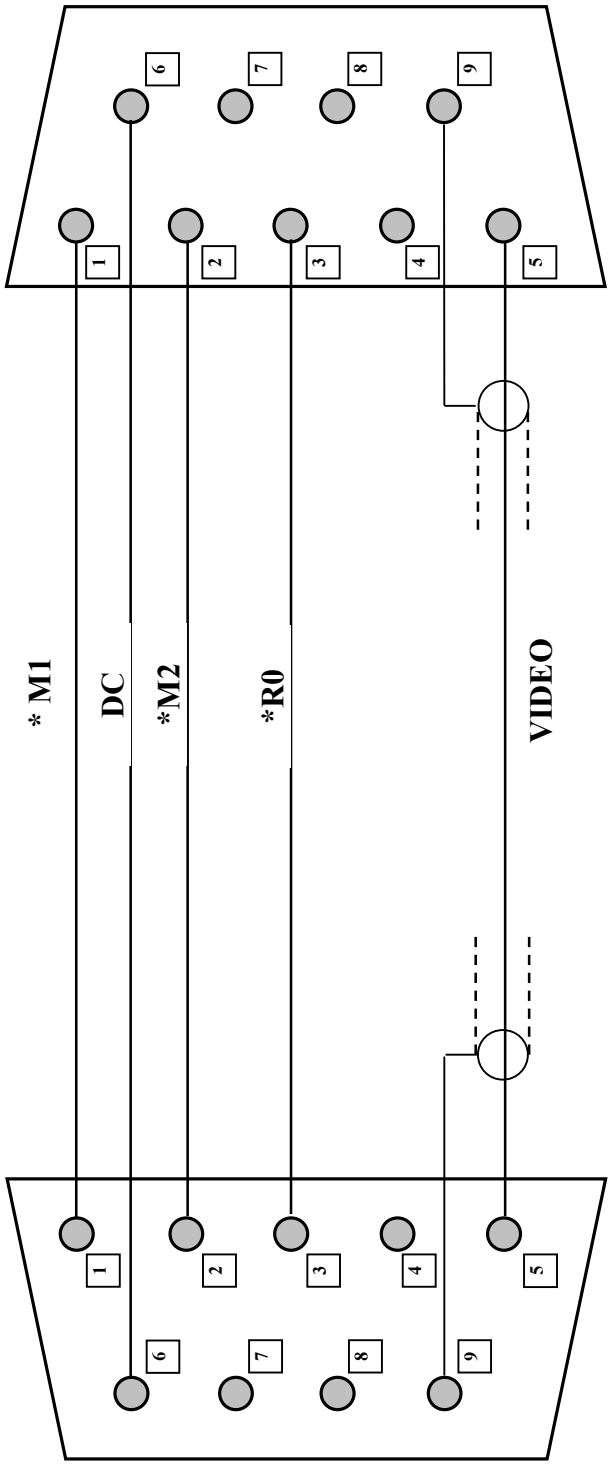
The system is adjustable in according to have a gamma 0, 4. The gamma value can be modified to 1 moving jumper J6. The video level of gamma correction is adjustable using trimmer R94 and it never must modify other than it necessary to change some components. In according to make these adjustments apply a video input (CCD camera head) of 3Vpp and regulate this trimmer until to obtain a value of 0,7Vpp on output VIDEO 1.

9. CCD CAMERA CONNECTORS

The CCD camera N23 connectors can be divided as follow:

1. **CCD CAMERA HEAD CONNECTOR (DB9)**
2. **COMMANDS INTERFACE CONNECTOR (DB25)**

9.1. CCD camera head connector

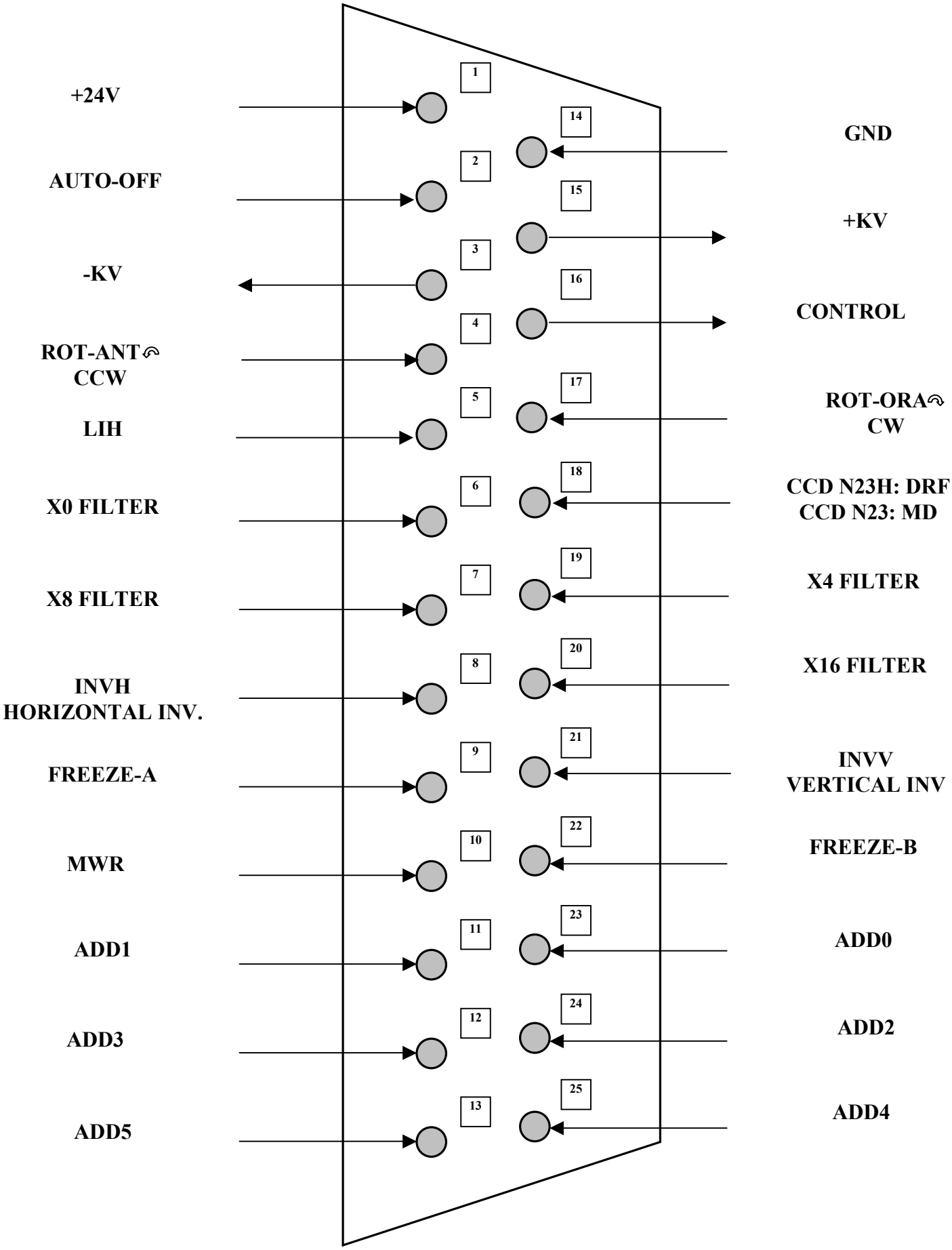


FEMALE
(SOLDERING VIEW)

*: ONLY FOR ROTATION

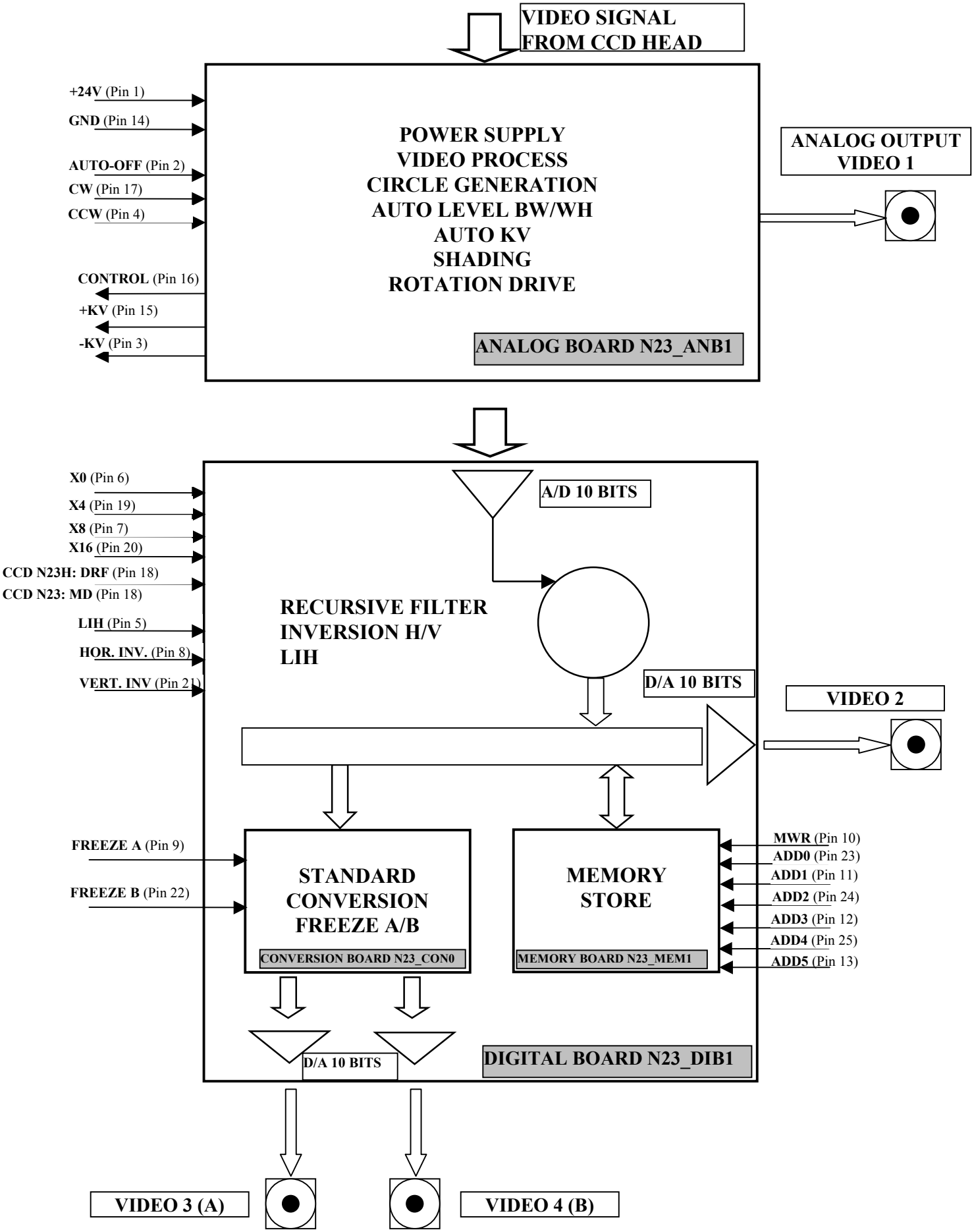
COMMAND	DESCRIPTION
M1 PIN 1	Command motor 1
DC PIN 6	Power Supply
M2 PIN 2	Command motor 2
R0 PIN 3	Command rotation 0
GND PIN 9	Ground video signal
VIDEO PIN 5	Video signal

9.2. Command


+24V
AUTO-OFF
-KV
ROT-ANT↶ CCW
LIH
X0 FILTER
X8 FILTER
INVH HORIZONTAL INV.
FREEZE-A
MWR
ADD1
ADD3
ADD5
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
GND
+KV
CONTROL
ROT-ORA↷ CW
CCD N23H: DRF CCD N23: MD
X4 FILTER
X16 FILTER
INVV VERTICAL INV
FREEZE-B
ADD0
ADD2
ADD4

NAME	SIGNAL	PIN	DESCRIPTION
+24V	**IN**	**1**	POWER SUPPLY: 20÷30 V
GND	**IN**	**14**	GROUND REF.
AUTO-OFF	**IN**	**2**	AUTOMATIC WHITE LEVEL. OPEN: ON GND: OFF
-KV	**OUT**	**3**	OUT= +18V IF DOSE IS TOO LOW. OUT= 0V IF DOSE IS CORRECT OR TOO HIGH.
+KV	**OUT**	**15**	OUT= +18V IF DOSE IS TOO HIGH. OUT= 0V IF DOSE IS CORRECT OR TOO LOW.
CONTROL	**OUT**	**16**	ANALOG KV CONTROLL. OUT= 0÷12 V. OUT = 0V IF DOSE IS TOO LOW. OUT = 12V IF DOSE IS TOO HIGH. OUT = 6V IF DOSE IS BALANCED.
ROT-ORA CW	**IN**	**17**	GND: CLOCK WISE ROTATION. IF GND AT THE SAME TIME WITH PIN 4 (ROT-ANT) RESET TO 0° ANGLE.
ROT-ANT CCW	**IN**	**4**	GND: ANTI CLOCK WISE ROTATION. IF GND AT THE SAME TIME WITH PIN 11 (ROT-ORA) RESET TO 0° ANGLE
LIH	**IN**	**5**	OPEN: LIVE IMAGE GND: LAST IMAGE OLD
DRF CCD N23H	**IN**	**18**	OPEN: DYNAMIC RECURSIVE FILTER GND: STANDARD RECURSIVE FILTER
MD CCD N23	**IN**	**18**	OPEN: MOTION DETECTION GND: STANDARD RECURSIVE FILTER
X0, X4, X8, X16 ALL HIGH LEVEL			NOISE FILTER = 2
X0	**IN**	**6**	GND: NOISE FILTER = 0
X4	**IN**	**19**	GND: NOISE FILTER = 4
X8	**IN**	**7**	GND: NOISE FILTER = 8
X16	**IN**	**20**	GND: NOISE FILTER = 16
INVH HOR. INV.	**IN**	**8**	OPEN: REAL IMAGE GND: HORIZONTAL IMAGE INVERSION
INVV VERT. INV.	**IN**	**21**	OPEN: REAL IMAGE GND: VERTICAL IMAGE INVERSION
FREEZE-A	**IN**	**9**	OPEN: LIVE IMAGE GND: FREEZE THE IMAGE IN VIDEO 3
FREEZE-B	**IN**	**22**	OPEN: LIVE IMAGE GND: FREEZE THE IMAGE IN VIDEO 3
MWR	**IN**	**10**	SEE MEMORY OPERATION
ADD0	**IN**	**23**	SEE MEMORY OPERATION
ADD1	**IN**	**11**	SEE MEMORY OPERATION
ADD2	**IN**	**24**	SEE MEMORY OPERATION
ADD3	**IN**	**12**	SEE MEMORY OPERATION
ADD4	**IN**	**25**	SEE MEMORY OPERATION
ADD5	**IN**	**13**	SEE MEMORY OPERATION

9.3. Block diagram CCU rack N23



10. FUNCTION AND MEMORY CONTROL

10.1. Memory function of CCD camera

The pins used for memory function are the following 10;
LIH, FREEZE_A, FREEZE_B, MWR, ADD0, ADD1, ADD2, ADD3, ADD4, ADD5.
There are 5 memory modes listed below.

- **Direct access mode**. Allows the recording or display of the first 32 positions of memory.
- **Manual selection mode**. Allows the user to move indicator to desired position to guarantee recording/playback at a specific position.
- **Multiple Cine-Loop mode without reset**. Allows the recording/ playback of images in sequential order at a selected speed starting from actual indicator position.
- **Single Cine-Loop Mode with reset**. Allows the recording/playback of images in sequential order at a selected speed starting from initial (first) indicator position.
- **Erasing Memory**. Allows the erasing of the full memory.

10.2. Recording to and playback from memory modes.

The MWR write/read command signal manages the memory storage operations described as follow:

ATTENTION: 0 = GROUND 1 = OPEN

MWR	DESCRIPTION
0	**Memory Write**. If MWR= GND user can record an image to the memory. The video input (Live or LIH) present on BUS is transferred to the memory at the position where indicator is found and with selected mode. (See list of modes.)
1	**Memory Read**. If MWR= OPEN (1) user can playback an image from the memory. The frame displayed will correspond to indicator position at this time. The frame will be transferred to BUS with selected mode. (See list of modes.)

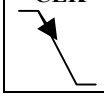
Monitor visualization (APPLICATIONS):

MWR	FREEZE A	FREEZE B	LIH	DESCRIPTION
0	X	X	1	Write memory with the image present on BUS (LIVE), for all the setting-value of the other 3 commands.
1	X	X	1	LIVE (images from camera head) Memory stand-by.
1	1	X	0	Read memory frames and images are transferred on monitor A
1	X	1	0	Read memory frames and images are transferred on monitor B
1	1	1	0	Read memory frames and images are transferred on both monitor A and B
X	0	X	X	FREEZE A. Image on monitor A frozen.
X	X	0	X	FREEZE B. Image on monitor B frozen.

10.3. Direct access memory (ADD5=1)

ADD5	ADD4	ADD3	ADD2	ADD1	ADD0	DESCRIPTION
1	**1**	**1**	**1**	**1**	**1**	If MWR=0 the image on the BUS (Live or LIH) is recorded at the first position. If MWR =1 the recorded image is read at position 1 and transferred to BUS for display
1	**1**	**1**	**1**	**1**	**0**	Same as above record/read memory at position 2
1	**1**	**1**	**1**	**0**	**1**	Same as above record/read memory at position 3
1	**1**	**1**	**1**	**0**	**0**	Same as above record/read memory at position 4
1	**1**	**1**	**0**	**1**	**1**	Same as above record/read memory at position 5
1	**1**	**1**	**0**	**1**	**0**	Same as above record/read memory at position 6
1	**-**	**-**	**-**	**-**	**-**	Same as above record/read memory for the others position
1	**0**	**0**	**0**	**0**	**0**	Same as above record/read memory at position 32

10.4. Manual selection mode (ADD5=0, ADD1=1, ADD0=0)

ADD5	ADD4	ADD3	ADD2	ADD1	ADD0	DESCRIPTION
0	**RESET**	**0=DWN 1=UP**	**CLK** 	**1**	**0**	**MANUAL UP OR DOWN MODE**
0	**1**	**1**	**CLK** 	**1**	**0**	**(UP)** The indicator of frame memory position is moved to the next **successive** position. (position ⇐ position+1)
0	**1**	**0**	**CLK** 	**1**	**0**	**(DOWN)** The indicator of frame memory position is moved to **preceding** frame in memory. (position ⇐ position-1)
0	**CLK** 	**X**	**X**	**1**	**0**	**(RESET)** The indicator of frame memory position is moved to **initial** frame of stored image sequence. (position = 1)

10.5. Multiple cine-loop mode without position reset (ADD5=0, ADD1=0, ADD0=1)

ADD5	ADD4	ADD3	ADD2	ADD1	ADD0	DESCRIPTION
0	**X**	**X**	**X**	**0**	**1**	**MULTIPLE CINE-LOOP MODE WITHOUT RESET** In this mode the record/playback starts from the actual position found. (MWR) increasing frame by frame automatically at the selected speed rate. In this mode it is possible to acquire a series of different segmented images at various times. During a successive playback of all the images in the memory it is possible to read the different phases of an exam recorded at different times.
0	**1**	**1**	**1**	**0**	**1**	Speed **25 (30) Frames per second** When **MWR=0** images are acquired into the memory at 25 (30) fps. Starts at actual position of indicator. When **MWR=1** images are read (playback) from memory at 25 (30) fps. Starts at actual position of indicator.
0	**1**	**1**	**0**	**0**	**1**	Speed**12 (15)fps**
0	**1**	**0**	**1**	**0**	**1**	Speed **6 fps**
0	**1**	**0**	**0**	**0**	**1**	Speed **3 fps**
0	**0**	**1**	**1**	**0**	**1**	Speed **1 fps**
0	**0**	**1**	**0**	**0**	**1**	Speed **0.5 fps**
0	**0**	**0**	**1**	**0**	**1**	Speed **0.25 fps**
0	**0**	**0**	**0**	**0**	**1**	**Single Shot** When **MWR=0** the user acquires ONE image into memory at the actual position of indicator. When **MWR=1** the user can read ONE image from the memory at the actual position of indicator. In both cases the frame number is automatically increased to the next position after the recording or the playback of an image

10.6. Multiple cine-loop mode with position reset (ADD5=0, ADD1=0, ADD0=0)

ADD5	ADD4	ADD3	ADD2	ADD1	ADD0	DESCRIPTION
0	**X**	**X**	**X**	**0**	**0**	**MULTIPLE CINE-LOOP MODE WITH RESET** During this mode the recording or playback **always** starts at the first position (position = 1) regardless of the position of the frame number indicator at MWR. The frame memory number position increases automatically at the selected frame rate speed.
0	**1**	**1**	**1**	**0**	**0**	Speed **25 (30) Frames per second** When **MWR=0** images are acquired into the memory at 25 (30) fps starting at position =1. When **MWR=1** images are read at 25 (30) fps starting at position=1.
0	**1**	**1**	**0**	**0**	**0**	Speed**12 (15)fps**
0	**1**	**0**	**1**	**0**	**0**	Speed **6 fps**
0	**1**	**0**	**0**	**0**	**0**	Speed **3 fps**
0	**0**	**1**	**1**	**0**	**0**	Speed **1 fps**
0	**0**	**1**	**0**	**0**	**0**	Speed **0.5 fps**
0	**0**	**0**	**1**	**0**	**0**	Speed **0.25 fps**
0	**0**	**0**	**0**	**0**	**0**	**Single Shot** When **MWR=0** The memory acquires **ONE** image only starting at position = 1 When MWR**=1** only **ONE** image is read from the memory at position=1. In both cases the memory increases automatically frame by frame during recording or playback.

10.7. Erasing memory mode (ADD5=0, ADD1=1, ADD0=0)

ADD5	ADD4	ADD3	ADD2	ADD1	ADD0	DESCRIPTION
0	**X**	**X**	**X**	**1**	**1**	***ERASING MEMORY***
0	**0**	**0**	**0**	**1**	**1**	Full erasing memory if signals contemporary GND more than 1,5 sec.

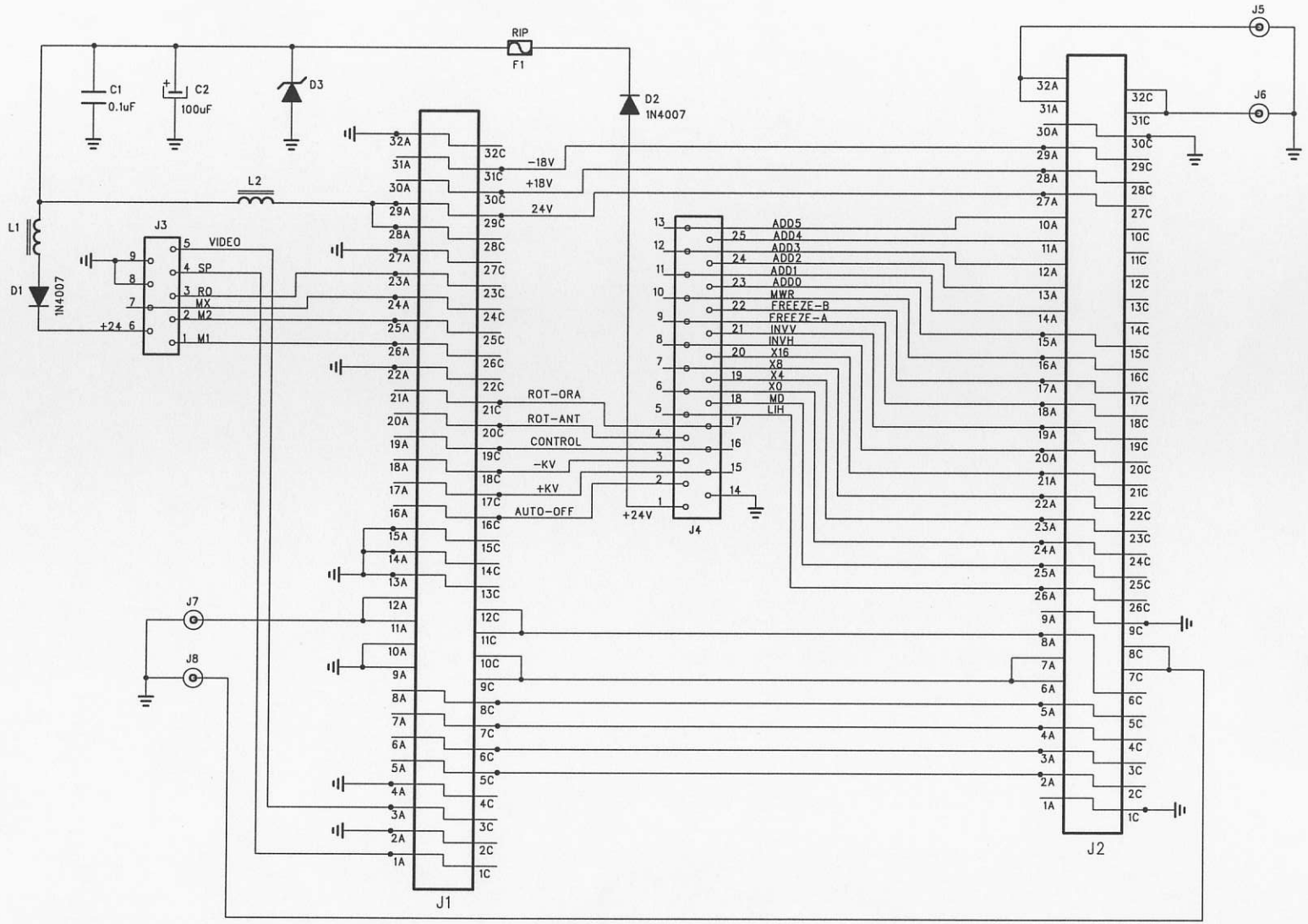
11. ELECTRICAL DIAGRAMS

11.1. General circuit diagram and block diagram of N23 CCD system.

Boards	Description
N23_MB0	Mother board N23
N23_ANB1	Video board diagram, Auto KV, electronic circle generator and camera head rotation
N23_DIB1	Digital board diagram, A/D converter, LIH, sweep reversal, recursive filter and DRF.
N23_CON0	Conversion board diagram, standard video and inversion
N23_MEM1	Memory frames diagram
NCD_XCD01	CCD sensor block
NCD_XCD02	Power supply board CCD head

NICAL S.p.A.
Via Soffredini, 43
20126 – Milano
ITALY
Tel.+39-02-2571110
FAX.+39-02-2572207

email: nical@nical.com
http:\\www.nical.com



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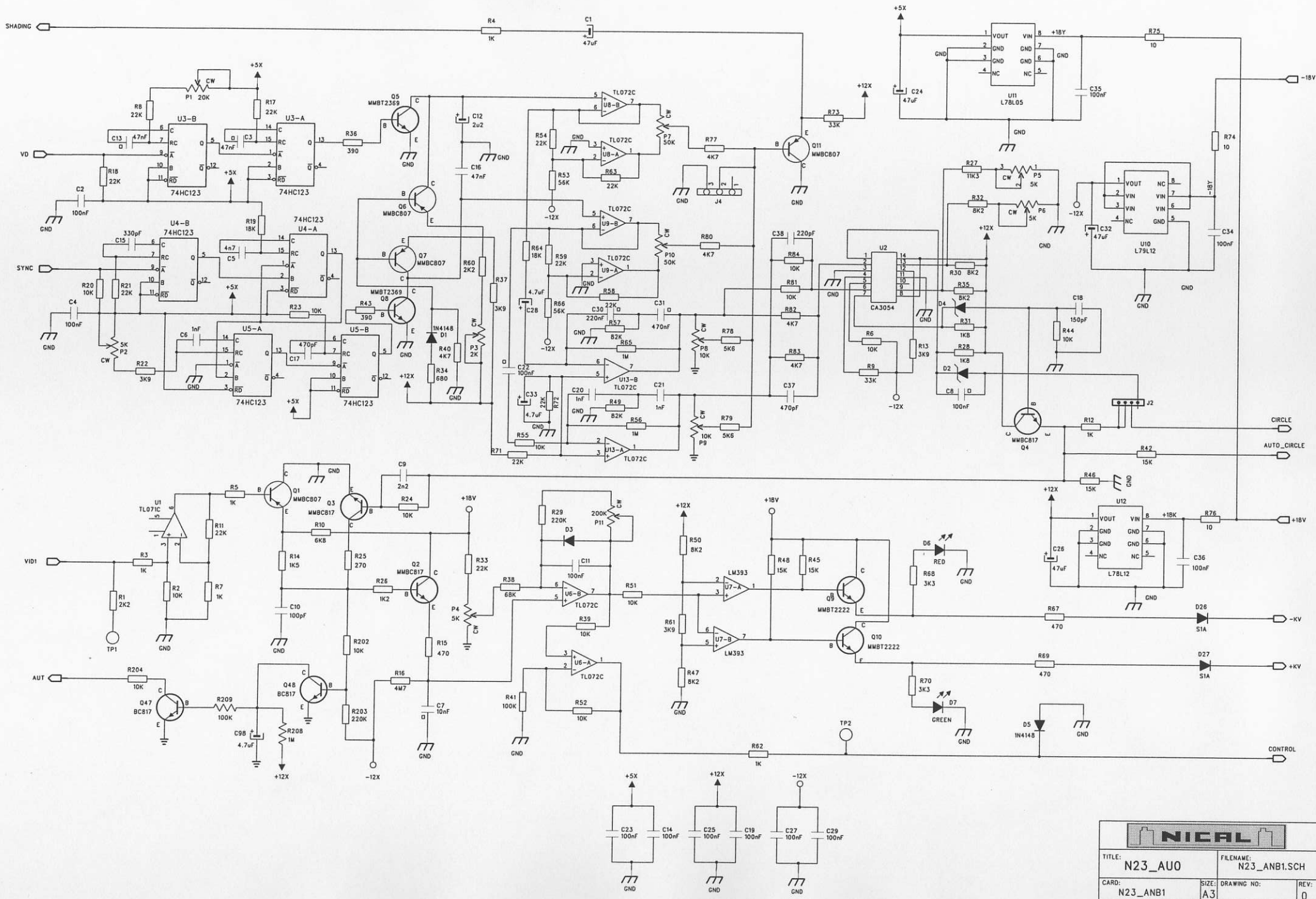

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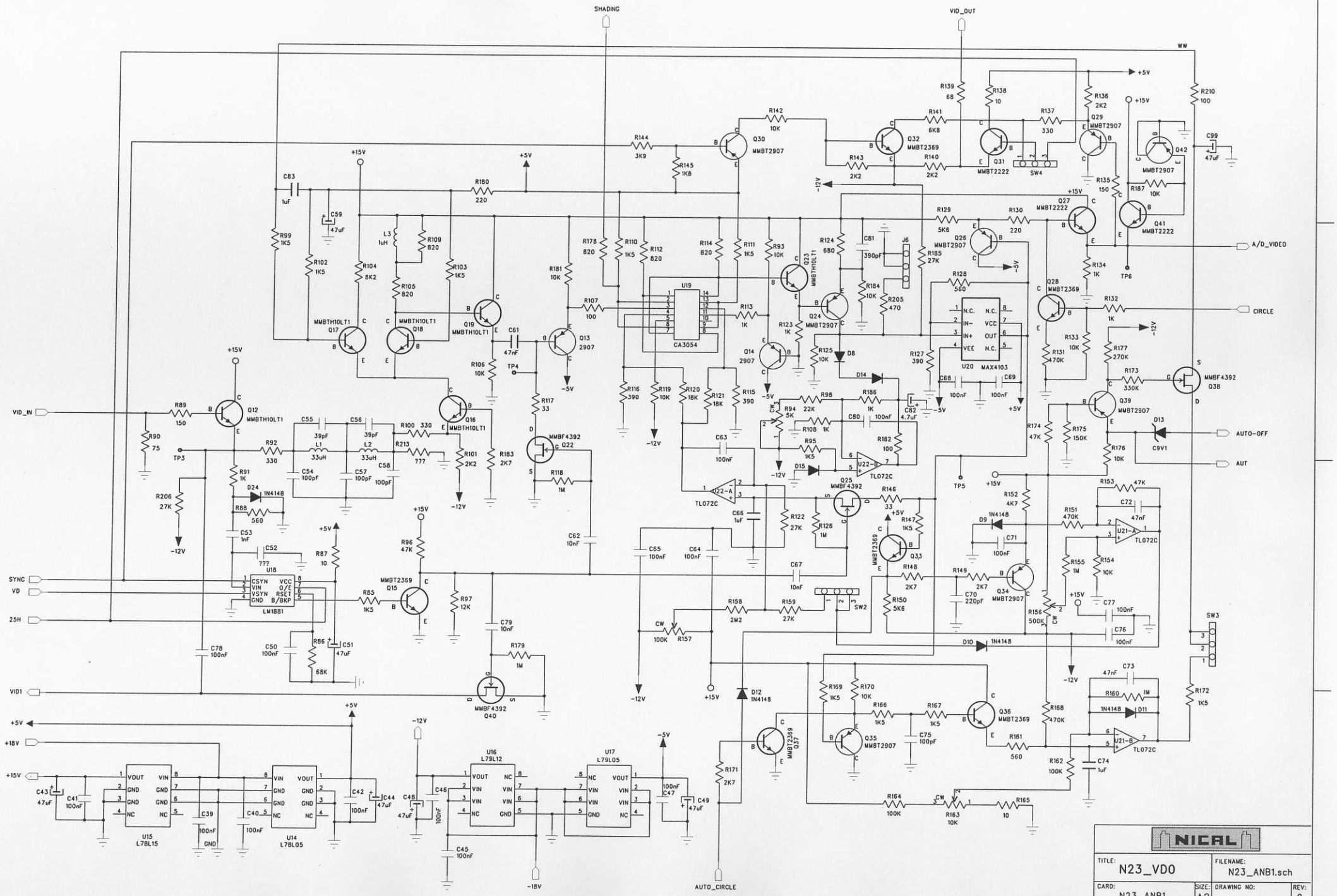
SHADING
VID_OUT
WW
A/D_VIDEO
CIRCLE
AUTO-OFF
AUT
VID_IN
SYNC
VD
25H
VID1
AUTO_CIRCLE
+5V
+15V
-12V
-5V
+18V
-18V
CA3054
MAX4103
TL072C
LM1881
L78L15
L78L05
L79L12
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MMBT2369
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MMBF4392
1N4148
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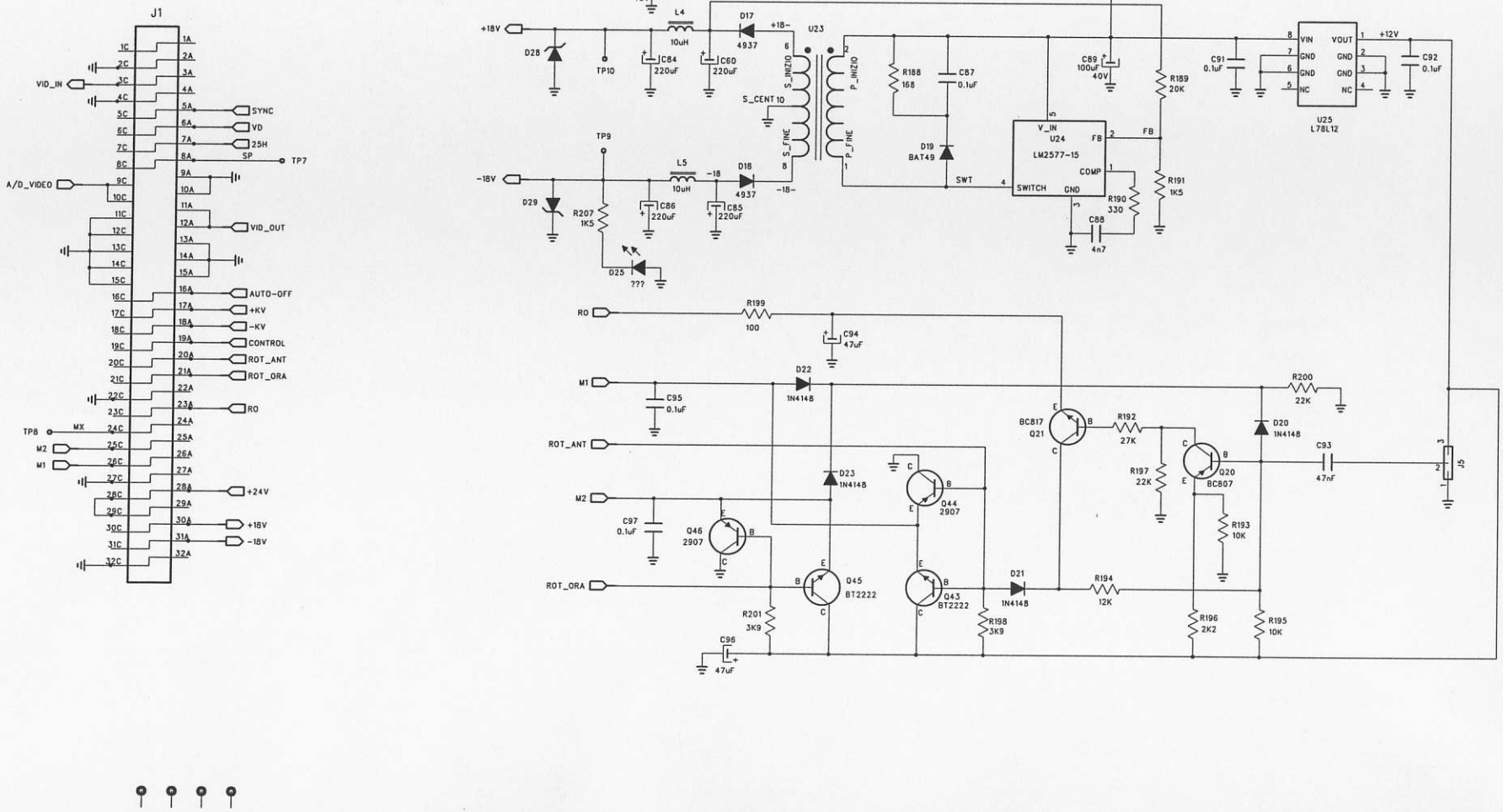
CARD: N23_ANB1
SIZE: A2
DRAWING NO:
REV: 0
DATA: 14/04/03
SHEET: 3 OF 4



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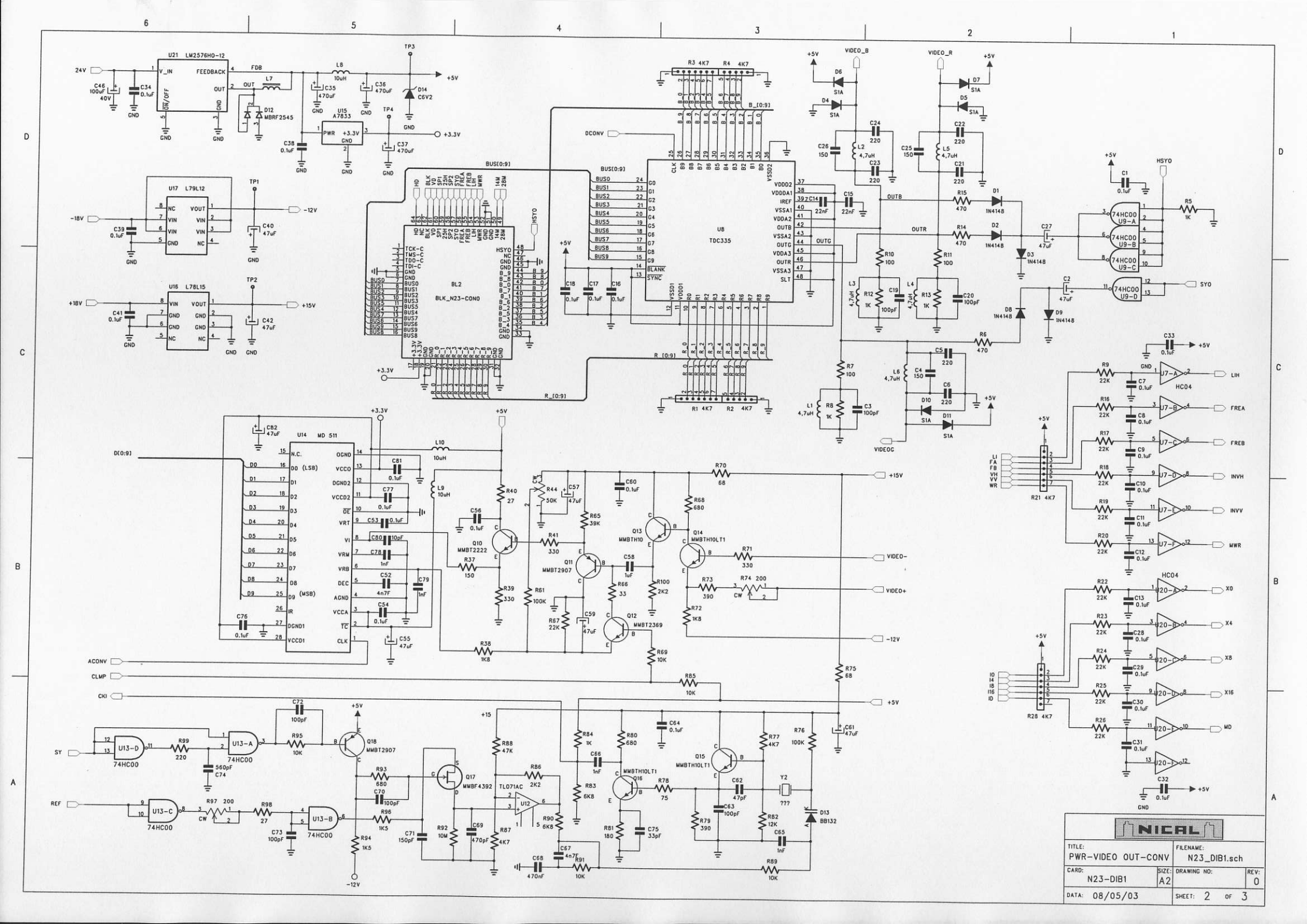
CARD: N23_ANB1	SIZE: A2	DRAWING NO:	REV: 0
DATA: 14/04/03		SHEET: 4 OF 4	


U21 LM2576HO-12
U17 L79L12
U16 L78L15
U15 A7833
U8 TDC335
BL2 BLK_N23-CONO
U14 MD 511
U13-A 74HC00
U13-B 74HC00
U13-C 74HC00
U13-D 74HC00
U12 TLO71AC
U9-A 74HC00
U9-B 74HC00
U9-C 74HC00
U9-D 74HC00
U7-A HC04
U7-B HC04
U7-C HC04
U7-D HC04
U7-E HC04
U7-F HC04
U20-A HC04
U20-B HC04
U20-C HC04
U20-D HC04
U20-E HC04
U20-F HC04
+5V
+3.3V
+15V
-12V
-18V
+18V
24V
GND
VIDEO_B
VIDEO_R
VIDEOG
VIDEO-
VIDEO+
HSYO
SYO
LIH
FREA
FREB
INVH
INVV
MWR
MD
X0
X4
X8
X16
SY
REF
ACONV
CLMP
CKI
D[0:9]
BUS[0:9]
R_[0:9]
B_[0:9]
OUTB
OUTR
OUTG
DCONV
NICAL
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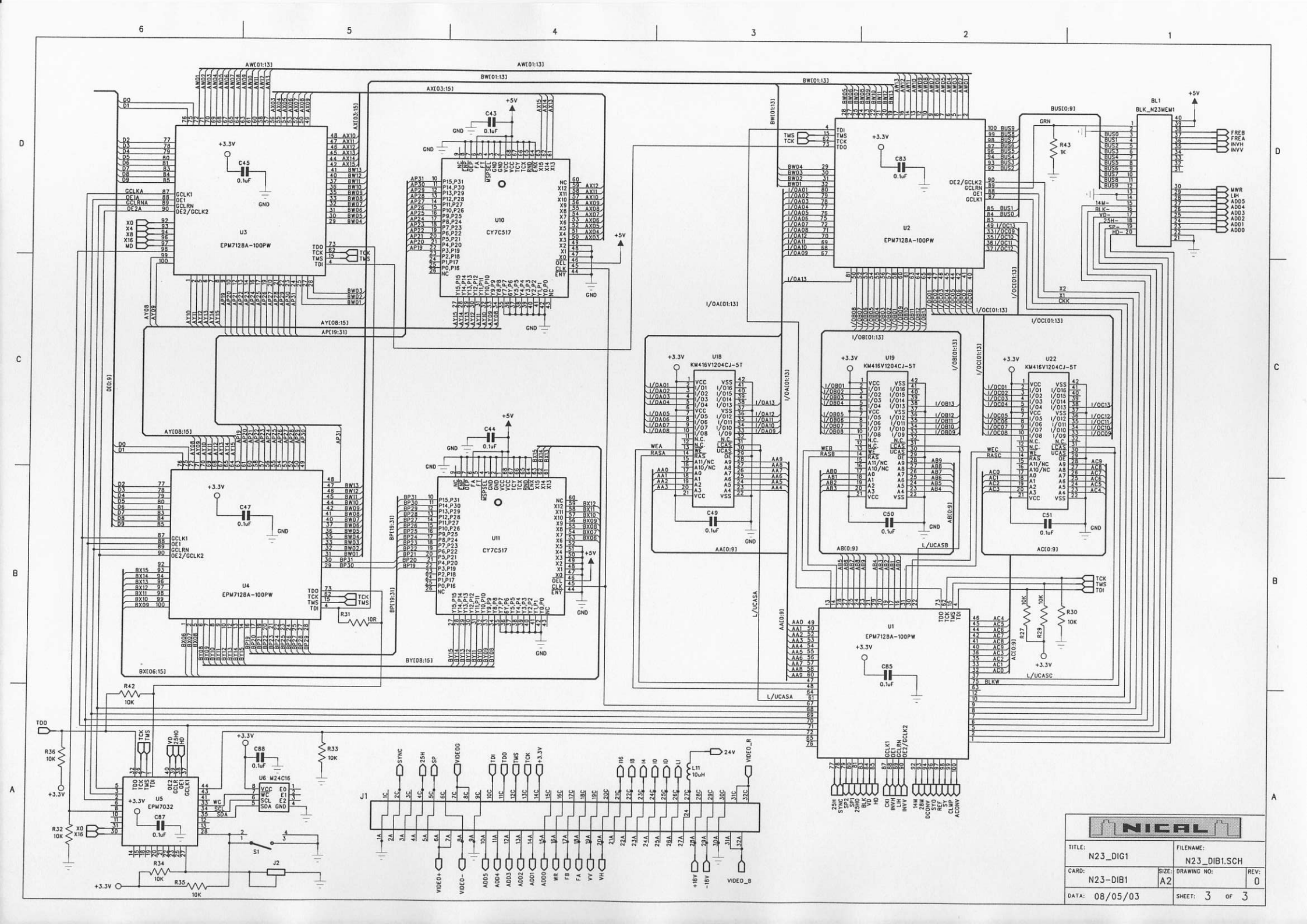
CARD: N23-DIB1
SIZE: A2
DRAWING NO:
REV: 0
DATA: 08/05/03
SHEET: 2 OF 3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CARD: N23-DIB1
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DRAWING NO:
REV: 0
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U2 EPM7128A-100PW
U3 EPM7128A-100PW
U4 EPM7128A-100PW
U5 EPM7032
U6 M24C16
U10 CY7C517
U11 CY7C517
U18 KM416V1204CJ-5T
U19 KM416V1204CJ-5T
U22 KM416V1204CJ-5T
BL1 BLK_N23MEM1
J1
J2
S1
L11 10uH
R27 10K
R29 10K
R30 10K
R31 10R
R32 10K
R33 10K
R34 10K
R35 10K
R36 10K
R42 10K
R43 1K
C43 0.1uF
C44 0.1uF
C45 0.1uF
C47 0.1uF
C49 0.1uF
C50 0.1uF
C51 0.1uF
C83 0.1uF
C85 0.1uF
C87 0.1uF
C88 0.1uF
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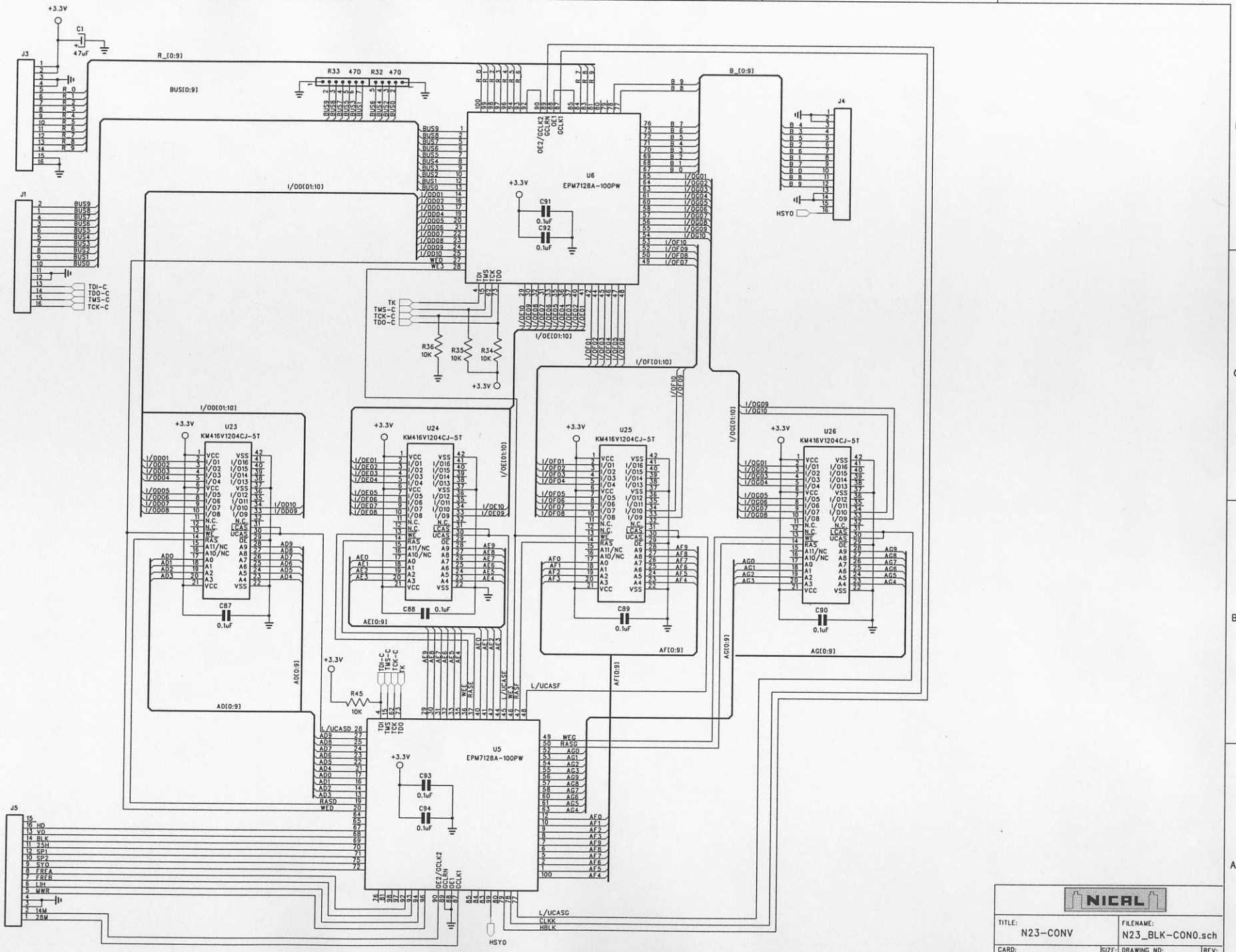
BW[01:13]
AX[03:15]
AY[08:15]
AP[19:31]
BP[19:31]
BX[06:15]
BY[08:15]
DI[0:9]
I/OA[01:13]
I/OB[01:13]
I/OC[01:13]
AA[0:9]
AB[0:9]
AC[0:9]
BUS[0:9]
L/UCASA
L/UCASB
L/UCASC
+5V
+3.3V
GND
24V
TDO
TCK
TMS
TDI
VIDEO_R
VIDEO_B
VIDEO+
VIDEO-


+3.3V
C1
47uF
J3
R_[0:9]
BUS[0:9]
R33 470
R32 470
B_[0:9]
J4
HSYO
J1
TDI-C
TDO-C
TMS-C
TCK-C
I/OD[01:10]
U6
EPM7128A-100PW
C91
0.1uF
C92
0.1uF
TK
R36
10K
R35
10K
R34
10K
I/OE[01:10]
I/OF[01:10]
I/OG[01:10]
U23
KM416V1204CJ-5T
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U25
KM416V1204CJ-5T
U26
KM416V1204CJ-5T
C87
0.1uF
C88
0.1uF
C89
0.1uF
C90
0.1uF
AD[0:9]
AE[0:9]
AF[0:9]
AG[0:9]
R45
10K
U5
EPM7128A-100PW
C93
0.1uF
C94
0.1uF
L/UCASD
L/UCASF
L/UCASG
RASD
WED
J5
HD
VD
BLK
25M
SP1
SP2
SYO
FREA
FREB
LH
MWR
14M
28M
CLKK
HBLK
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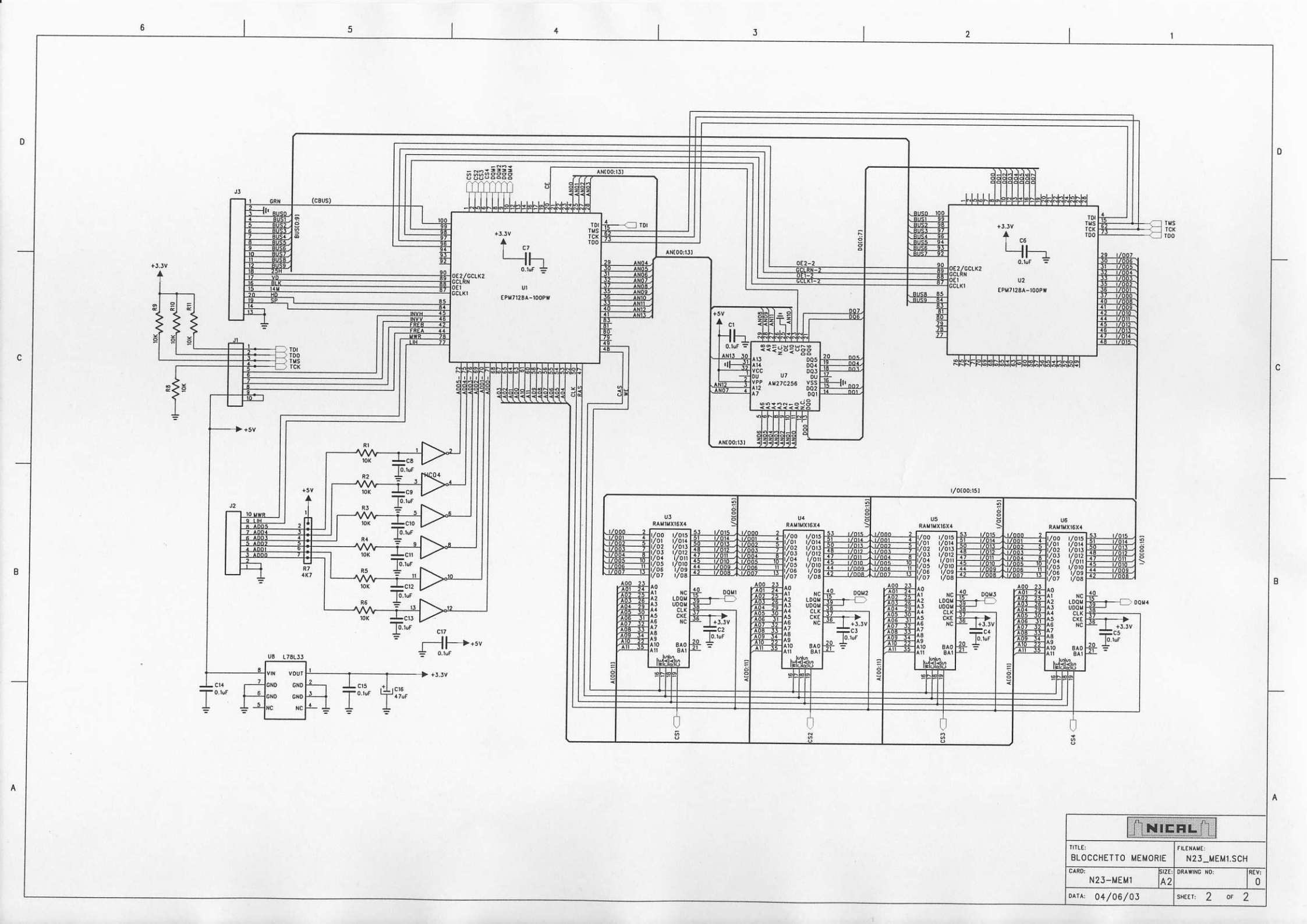
CARD: N23-CON0
SIZE: A2
DRAWING NO:
REV: 0
DATA: 02/04/03
SHEET: 2 OF 2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FILENAME: N23_MEM1.SCH
CARD: N23-MEM1
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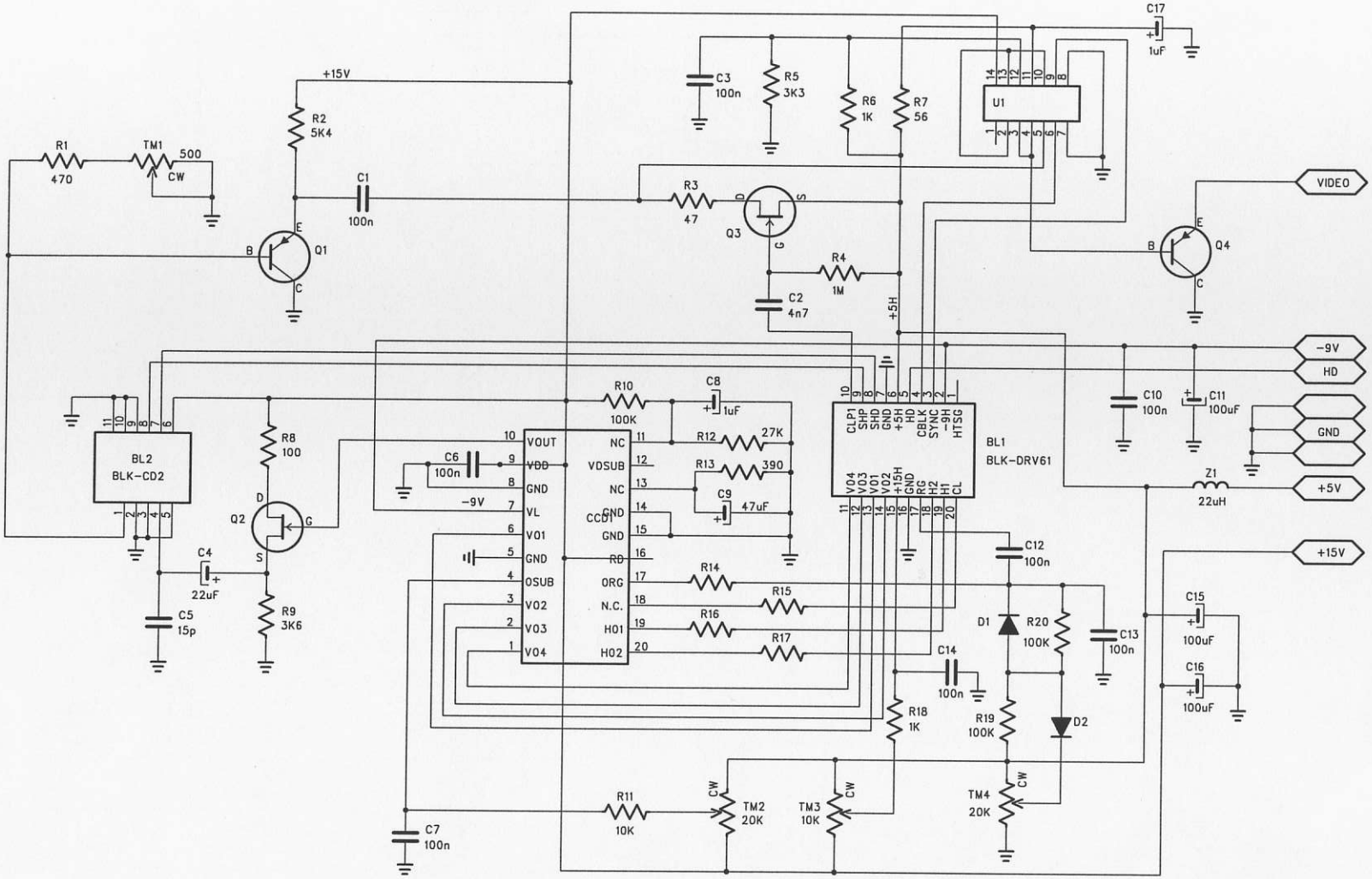
DRAWING NO:
REV: 0
DATA: 04/06/03
SHEET: 2 OF 2



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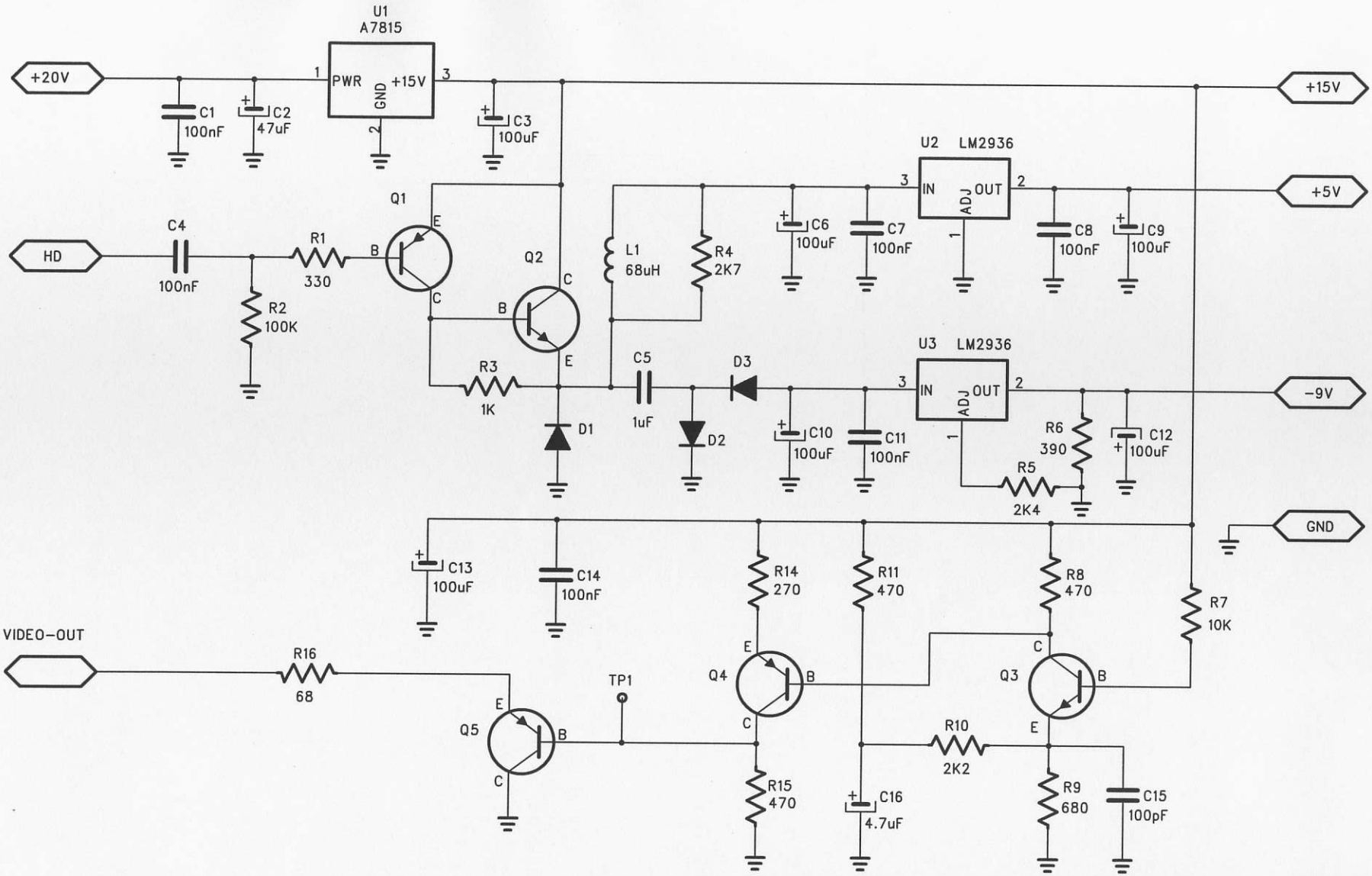
DATA: 18/02/03		SHEET: 2 OF 2	



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CARD: XCD02	SIZE A4	DRAWING N:	REV: 0
DATA 18/02/03		SHEET: 2 OF 2	