TATUNG F Series

General Information

Covers
Proline
1420R, 1420T.
Tatung
T14RF70, T14TF70, T20TF70,
D14RFG5, D14TFG5,
D20TFG5, D21TFG5,
F1/F1W/F2W/F4W Chassis.

Recommended Safety Parts

Item	Part No.	Description	Val.	Tol.%	Volts	Xpos	Ypos
C801	5270106201	AC Mains X2	220n	20	250	B	6
C804	5230133201	AC R12.5 CIsY	3n3	20	400	C	6
R415	5140101001	Fusible	1R	5	0.5	C	2
R416	5140101001	Fusible	1R	5	0.5	C	2
R433	5133110003	Fusible	10R	5	0.5	C	2
R804	5140147590	Metal glaze	4M7	5	0.5	C	5
R805	5140147590	Metal glaze	4M7	5	0.5	C	6
R814	5130239807	Metal oxide	0R39	5	0.5	B	5
R816	5133122803	Fusible	0R22	5	0.5	B	5
R821	5133122803	Fusible	0R22	5	0.5	C	5
R915	5133168803	Fusible	0R68	5	0.5	C	7
						Xpos	Ypos
I402	6642900200	Photo-coupler				C	3/4
T801	5061700200	Filter EMI transformer type				B	6
T802	5061800101	S.M.P.S.U.				C	5
T401	5062690328	Flyback				A	2
T401	5062690228	Flyback				A	2
P902A	5056390028	CRT base socket mini-neck				B	7
P902	5056306736	CRT socket SFCBAO8I2A-TT				B	7
F801	5054420033	2A Time-lag fuse				C	6
	5053500110	Mains On/Off switch PCB					
	5054524488	On/Off Switch 2 pole push-push power					
(14" Only)	5051290006	CRT A34AGT13X38P					
(21" Only)	5051290005	CRT A51AEZ90X13					
(20" Only)	5051290004	CRT A48AGY13X71					
(14")	5056790002	Mains lead 13A plug with filter					
(20")	5056790002	Mains lead 13A plug with filter					
(21")	5056790002	Mains lead 13A plug with filter					
(14" Only)	87-0017-6-004	Degaussing coil					
(20" Only)	85-9660-3-008	Degaussing coil					
(21" Only)	87-0048-6-004	Degaussing coil					

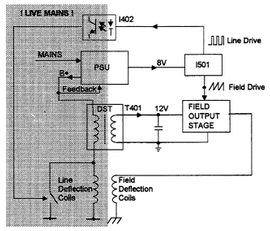
Safety Instructions

SAFETY AND ISOLATION

1) Under no circumstances should any form of repair or maintenance be attempted by any person other than a competent technician or engineer. The following precautions must be observed:
2) For purposes of servicing, the chassis should be supplied from an isolation transformer of at least 150W rating.
3) If disturbed, the original lead dressing should be restored. This is particularly important due to the 'hot coil' nature of the chassis. Lead dressing will also have a beanng on the EMC performance of the chassis.
4) Components marked "!" on the circuit diagram are safety approved types and have special safety related characteristics. Only the manufacturers replacement components should be used. Replacement with alternative or up-rated' parts e.g. higher power resistors definitely does not guarantee the same level of protection and may create a fire, electric shock or X-radiation hazard.
5) Components not bearing the "!" mark should still be replaced with the originally fitted type and should be mounted in the same way.

1.1 The Isolation Barrier

The chassis is a 'hot-coil' chassis whereby the line deflection coils are NOT isolated from the mains since the PSU does not provide B+ rail isolation. Consequently the mains isolation barrier is more convoluted than in a conventional chassis and a much larger portion of the chassis is non-isolated. Figure 1 shows the isolation barrier position in the chassis.



- Mains Isolation Barrier Positions -

It can be seen that both the DST (T401) and the scan coils now straddle the isolation barrier and are, as such, safety critical components. Also, the opto~coupler (I402) is required to pass line drive from I501 on the 'cold' side to the line drive stage on the 'hot' side. The isolation barrier therefore consists of T802, T401, I402, C804, R804, R805, the scan coils and 6mm air gaps. To maintain barrier integrity care should be taken not to reduce any air gaps, e.g. by protruding wires, following component replacement. Deflection yoke lead dressing is important to maintain double insulation across the isolation barrier. The position of the deflection lead sleeving is maintained by a tie wrap. Should this be removed for any reason, the sleeving should be slid towards the deflection yoke and tie wrapped into position.

1.2 Semiconductor Device Handling Precautions

The chassis contains devices which may be damaged by static electrical charge during handling, particularly I501, I602, I701 and Q801. To avoid damage, soldering irons should be earthed and service engineers should ideally wear wrist straps earthed through a 1M resistor or at least discharge themselves to an earthed point.

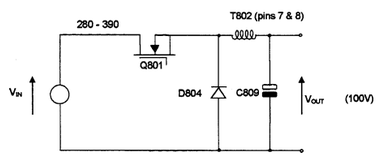
SWITCHED MODE POWER SUPPLY

3.1 Summary

The power supply is a self-oscillating discontinuous buck converter (step-down chopper) under peak current control and designed for up to 65W output power at nominally 98V. The main B+ output of this converter topology is inherently non-isolated and as such, output voltage feedback does not require an opto-coupler. Some energy is derived in flyback mode via an isolated winding on the buck inductor to provide a low power 10V secondary supply from which are derived switched 8V (video processor) and permanent 5V (µP) supplies.
In stand-by mode, both the B+ and 10V supplies remain dose to their nominal operating levels but with virtually zero load, the PSU enters a burst-mode whereby typically 180 in 200 cycles are skipped. In this way, the stand-by power consumption (including degaussing circuit) is less than 4W.

3.2 Description of Operation of the Buck Converter

Figure 4 shows the main components of the buck converter. The output voltage may be controlled between zero and the input voltage by varying the on-time of Q801. During this period, Vin-Vout is applied across the buck inductor Q802 winding pins 7 & 8) and the current in it ramps up lineaulY. When Q801 is turned off, -Vout is applied across the buck inductor and energy is delivered to the load and C809 combination.



- The Buck Converter -

3.3 Start-Up

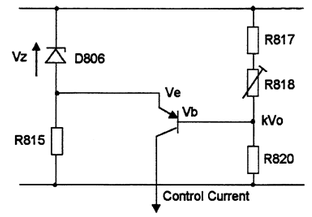
At start-up, the overwind output voltage Q802 winding pins 7 & 8) is not present so a start-up bias circuit is required. This consists of R806, D802 and R809. Approximately 16V is produced at the junction of R806 and D802 which is fed via R809 to turn on Q801 for the first time.

3.4 Control Method

During the on-time of Q801,the buck inductor voltage flows through the current sense resistor R814 forming an analogue of the buck inductor current. This is fed to the base of Q802 along with a DC bias current from the error amplifier (via R813) such that once a certain buck inductor current level is reached, Q802 turns on. When this happens Q801 is turned off and the inductor current free-wheels through D804. This is peak current-mode control.

3.5 Output Voltage Regulation

The non-isolated B+ rail means that no opto-isolator is required for direct Vo control. It can be seen from Figure 5 that Vo minus a small zener voltage drives the emitter of this transistor (Vo-Vz) whilst a resistive potential divider feeds the base (kVo, k<1). If, for instance, the output voltage tends to rise, Ve rises by AVO whereas Vb only rises by ΔkVo. The net result is an increase in negative bias and an increase in collector (control) current.
R818 in the potential divider provides an element of control over the B+ voltage.



- The Error Amplifier -

3.6 Overvoltage Protection

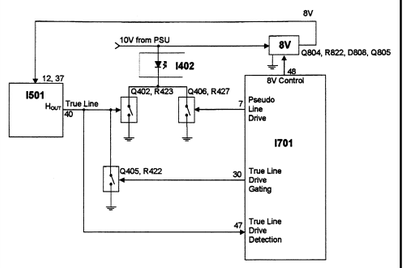
An unfortunate characteristic of the buck converter is that if the power switch Q801 should become short-circuit, the full rectified mains voltage appears at the output, over stressing components in both the PSU itself and the load. In order to limit the output voltage rise under these conditions, a 130V 5W zener diode D805 is fitted across the B+ output. An over-voltage causes conduction of D805, shorting the B+ output and blowing the fuse F801.

3.7 Isolated Supplies

In order to provide low voltage isolated supplies, a secondary winding is included on the buck inductor, phased such that energy is delivered in flyback mode, that is when Q801 is off. During this interval, the buck inductor voltage is clamped to the output voltage and the turns ratio is chosen to provide a secondary of 1 DV with rectification and smoothing performed by D807 and C812 and overload protection by R821. A permanent 5V µP supply is derived from this 10V supply by I801 as well as an 8V switched supply under µP control by Q804, R822, D808 and Q805.

3.8 Chassis Start-Up Procedure

The PSU used in the chassis has a characteristic which complicates start-up. Until a B+ load is established (i.e. the line output stage starts), the isolated secondaries are very high impedance - simply tuming on the video processor 8V supply and waiting for line-drive to start-up would fail since the supply cannot deliver I501's supply current. In order to overcome this problem, a system of 'pseudo line-drive' was devised which allows the line output stage to be driven by the µP in order to establish a B+ load prior to turn-on of the video processor 8V supply. Figure 6 is a block representation of this system.



- Start-up Circuit Block Diagram -

The two line drive sources are OR-ed together at the input of I402, the two driver transistors being Q402 and Q406. The pP is responsible for ensuring that both line drive sources cannot drive the output stage simultaneously and to achieve this, the true line drive from I501 is monitored (µP pin 47). In this way, the transition from pseudo to true line-drive is timed to the latter starting up. However, the line-drive stage does not reliably operate at 31kHz so the soft-start cycle of I501 must be gated out. The µP achieves this by keeping Q405 on for a fixed time after true line-drive has been detected thus keeping Q402 off. When this time has elapsed, pseudo line-drive is stopped and Q405 turned off simultaneously, completing the start-up Sequence.

On reverting to stand-by pin 7 reverts to the high state which maintains I402 in conduction via Q406. This maintains Q403 on and the line output transistor (Q404) off.

TUNER AND IF STAGES

4.1 Tuner

The main chassis is fitted with a voltage synthesis UHF tuner for system I. Control of the tuned frequency is achieved by a voltage on pin 2 of the tuner. This voltage is derived from integrating a 33 volt PWM switched waveform. This PWM waveform is derived from pin 1 of the microcontroller I701.

The AFC is sampled by the microcontroller via the I^2C bus from I501 and frequency correction is achieved by microcontroller adjustment of the duty cycle of the PWM which then modifies the tuner frequency.

4.2 AGC Adjustment

For most aerial input signal levels the tuner operates at maximum gain. At high signal levels the gain of the tuner is reduced by an AGC voltage generated in the IF stage. The AGC output from the IF (pin 54 of I501) is applied to pin 1 of the tuner (H001).

The AGC maintains a maximum IF voltage of 600mV peak to peak. The voltage level can be adjusted using the following procedure:

Short circuit pins 2 and 3 of P701 to enter service mode. When in service mode use the programme up and down keys to select service parameter 13. Using a 40MHz or greater oscilloscope, monitor pin 11 of TU001.
Adjust service parameter 13 using the volume up and down keys for 600mV on pin 11 for a single ended tuner, and 300mV for a differential output tuner. Press the RV key to store the AGC value.

4.3 AFC Adjustment

The AFC voltage is not available at any point on the chassis; it is read by the microcontroller via the PC bus. Therefore, one of the following methods can be used to correctly align the AFC.

a) For demodulator tamk coil fitted
(I501 = TDA884X Mask 1)
Ensure there is no signal connected to H001. Fine tune a signal generator to a carrier frequency of 38.9MHz. Connect the signal generator output between pins 1 and 2 of X001 with signal pin connected to pin I and ground to pin 2. Adjust the signal generator carrier to 600mV peak to peak at pin I of X001.

Enter service mode by applying a short circuit to pins 2 and 3 of P701. When in service mode use the programme up and down keys to select service parameter 15. Adjust service parameter 15 using the volume up and down keys until the two bits at the top right of the screen meet the following criteria:

Left hand bit permanently set.
Right hand bit toggles (either 1 to 0 or 0 to 1).

When the AFC value has been set press the TV key to store it.

Remove the test equipment

b) For demodulator tamk coil not fitted
(I501 = TDA886X Mask 2)
Adjust service parameter 15 using the volume up and down keys until its value is 50. When the AFC value has been set press the TV key to store it.

4.4 Vision Decoding

The majority of the vision and sound, deflection and colour decoding is performed by I501. The IF signal passes from the tuner through the SAW filter (X001) to filter unwanted frequencies to I501. It is demodulated intemally and the output at pin 6 is buffered by Q501. The sound and vision components are now separated. Z501 removes the sound from the vision components and Z601/602 filters the FM sound to pin 1 for demodulation.
Video is then fed to the SCART socket output, pin 19 of P501 via Q502.

SOURCE SELECTION

Source selection is controlled by the microcontroller via PC bus commands. The video processor I501 can select between internal demodulated CVBS video on its pin 13, external CVBS video (AV1) from pin 20 of P501 on its pin 17 or, if available, from external CVBS video (AV2) from the yellow phono socket of PA501, which is applied to pin 11. The internally demodulated CVBS video is always available on pin 19 of P501.

External RGB is selected within 1501. Fast blanking pulses from pin 16 of P501 are passed via an OR-ing circuit of Q301-304 and associated components to pin 26 of 1501. This pin controls the state of the RGB outputs to the tube base pins 19, 20 and 21. It has three possible states:
1) Less than 0.4VInternal RGB from colour decoder.
2) Between 0.4V and 4.OVExternal RGB from pins 7,11 and 15.
3)Greater than 4VOutput blanked for OSD/Text insertion.
When teletext or OSD is displayed, pin 35 of I703 goes from ground to 5.0 Volts. This signal is passed via Q301 and causes pin 26 of 1501

Service Notes Cont'd

to enter the third state above, independent of the state of the other inputs to the OR circuit. During mixed TV/Text mode or whilst the OSD is showing on part of the screen this line will be switching at a high rate. RGB mode can be selected manually by the user and in this case the open-drain output on pin 8 of the micro-controller will be switched off and will be pulled up to 1.7 volts by R307 and R306. Q302 then applies a voltage of about 1.0 volts to pin 26 of I501. In the absence of a higher voltage via Q301 and Q303 from the fast blanking input, pin 16 of P501, this is still sufficient to enter the external RGB mode.

Audio source switching is controlled via the microprocessor I701. The audio is switched from internal to external source via 12C in I501. Internal source is fed to I501 at pin 1 and the external source at pin 2. On models equipped with front AV, the external source is provided either from pins 2 and 6 of P501 or the white phono socket PA501 .The external source selection is controlled by pin 3 of 1701 and Q703, then switched by I602. On models without front AV, I602 is omitted and bypassed via R601. On models equipped with a headphone socket, the speaker feed from the audio amplifier (I601) is diverted to the headphone when a headphone jack is plugged into PA601.

COLOUR DECODER

The luma signal processing and colour decoding are implemented by I501. The luminance and chrominance signals are separated internally. A delay line is also incorporated to compensate for the difference between the luma and chroma processing times. There are no adjustments required on the colour decoder.

6.1 On-Screen Display

The micro-controller on-screen display (OSD) supplies blanking and RGB signals for overlaying the television picture. Pin 35 of I701 provides blanking pulses which are applied to pin 26 of I501 via Q301, to turn off the decoder RGB output so that the OSD is clearly visible. The RGB signals from pins 34, 33 and 32 of I701 are applied directly to the tube-base via Q306 to Q308 and the text drive colour balance presents R317 and R319.

HORIZONTAL AND VERTICAL DEFLECTION

In addition to decoding and switching, I501 provides deflection processing for the horizontal and vertical time-base circuits. Using video from the IF or external source as appropriate, the timebase circuit of I501 produces horizontal drive pulses at pin 40 to switch horizontal drive transistor Q402, and a differential vertical ramp at pins 46 and 47 to drive the vertical deflection output amplifier (I401).

All geometry adjustments are performed via the 1^2C bus with the service parameters (see "Adjustments") with the exceptions of picture width (which is fine tuned by adjusting the B+ voltage by means of R818) and horizontal linearity (which is fixed by L402.)

7.1 Line Circuit

The primary side of the line circuit and the deflection coil are connected to the hot earth. The driver circuit contains an opto-coupler to create isolation between the low signal parts and the mains. The opto-coupler is driven by pin 40 of I501 via transistor Q402.

When Q402 is not conducting, the LED of the opto-coupler is also out of conduction, and Q403 is also not conducting. In this way, Q404 will conduct and the B+ voltage (100V) is placed across winding 2-1 of the line output transformer Q401). A voltage across winding 2-1 of the line output transformer Q401) will cause a voltage across the windings 6- 9, 7- 9, 8- 9 and 10.. 9. Energy is now transformed from the primary to the secondary side and charges capacitors C407 (+200V video supply), C408 (+1 3V field supply) and C409 (-1 3V field supply).

When transistor Q402 conducts, the LED of the opto-coupler is activated. This causes the transistor of the opto-coupler to conduct, which drives Q403 into conduction. This brings Q404 out of conduction. Due to this configuration, this circuit is protected against missing line-drive pulses. When a line-drive pulse is missed, the line output transistor (Q404) stays out of conduction, because the LED of the opto-coupler is forced into conduction by Q402 and R405 and R406. By this means, damage is avoided when there is no line drive.

The line output transistor is helped in its switching action by the extra winding 2-3 while C412 helps in the switching action and prevents Q404 overheating. C418 prevents Q404 from switching at twice line frequency. Line jitter is reduced by capacitor C417 in the collector of Q402.

On the secondary side of the line output transformer Q401) there is a blanking circuit which consists of C749 and R734, D501, D502 and D503. As Q404 switches off this circuit sends a pulse to pin 41 of I501 via R532 to blank the picture.

7.3 Horizontal Deflection

The voltage across capacitor C809 is the same as the voltage between B+ and the hot earth. (100V) When Q404 is conducting, this voltage is placed across the horizontal deflection coil via C411 and L402. This causes a linearly increasing current through this coil, thus creating horizontal deflection. When 0404 switches off, horizontal flyback takes place and then horizontal deflection is repeated and so on. C411 and L402 are used for linearity correction.

7.4 Vertical Deflection

Vertical deflection is based on a balanced input amplifier I401 connected to the +13V supply and -13V supply. This is driven from pins 46 and 47 of I501 via R407 and R408. A negative going ramp at field rate from I501 pin 46 is used to control I401. When the ramp is at its highest point, vertical flyback is generated at I401 output (pin 5) by means of C403 and D411 and a flyback generator internal to I401. After vertical flyback, the I401 output generates a negative going ramp across the field deflection coil which provides deflection until the next flyback pulse and so on. R413 is used to damp oscillation of the field deflection coil. Vertical deflection amplifier stability against self oscillation is maintained by R412, C404 and C402.

7.5 Vertical Protection

When operating normally, the vertical output stage generates a +5.5V pulse during vertical flyback blanking. This pulse is fed via Q407 to I501 beam current input. Should this pulse fail, the picture tube outputs are "blanked off" after 12 seconds and the microcontroller records a failure. For diagnostic purposes, vertical protection during the 12 second interval may be disabled by pressing the '2' key on the remote control hand unit when in service parameter 'QA'. This should always be re-enabled after repair (see "Adjustments").

TUBE BASE PANEL

The picture tube amplifiers produce high voltage CRT electrode drives from the low voltage RGB outputs of the TDA884x (I501). They also produce black current information to maintain the grey-scale characteristics which is returned to the colour decoder (I501). Also included is circuitry for picture blanking during switch on.

The picture tube aquadag, (P901), is used to provide beam current information for the colour decoder for the purposes of beam current limiting. The tubebase socket (P902) is fitted with internal spark gaps. D910 provides tube base protection when the spark gaps flash over. The panel includes supplies to the tube electrodes and the video amplifiers. Focus and A1 supplies are connected directly from the flying leads of T401.

8.1 Video Drives

All video drive adjustments are done via the 1^2C bus (see "Adjustments") with the exception of the black level set point (140V) which is set by the A1 control on the line output transformer T401). An additional feature for diagnostic purposes is the ability to disable the auto black level circuit by pressing '2' on the remote control hand set when in service parameter 02 (see "Adjustments")

8.2 Tubebase Video Amplifier Circuit

Each video amplifier channel includes a bipolar cascode amplifier. A R, G or B signal from the colour decoder (I501) is fed to each video amplifier input. The low frequency gain of each video amplifier is approximately 51, this being determined by the ratio of the feedback resistors to the input resistors. The gain of each video amplifier channel above 2.2 MHz is increased by including a small capacitor across one of the two input resistors of each channel.

8.3 Video Amplifier Switch-On Blanking

The emitters of Q906, Q907 and Q908 are biased from the +200V video HT via R91 7, R905 and Q910. The +13V supply to bias the base connections of Q902, Q905 and Q908 is switched on under control from microcontroller I701 pin 35 (via R435, Q408 and R434 on the main panel) during power up or from standby after emitter bias of Q906, Q907 and Q908 is established. Thus picture blanking during power up or from standby is ensured.

8.4 Auto Grey Scale

During the field blanking period the colour decoder (I501) measures the total cathode circuit leakage currents at the video amplifier outputs via Q901, Q902 and Q903:- During field blanking, the colour decoder applies monitoring pulses to the video amplifier inputs and thence current outputs from Q901, Q902, Q903 are applied to the colour decoder pin 18 via R904 and R516. (During normal unblanked picture operation, the colour decoder ignores the information on its pin 18.). The current outputs from Q901, Q902 and Q903 are used by I501 to adjust the black current and video gain of each video channel automatically. Thus black level picture beam current and black to white video drives are maintained. Diodes D903, D905 and D906 prevent horizontal smearing/shadowing of the OSD from spreading across the screen.

TDA884X VIDEO PROCESSOR

Pin	Designation	I/O	Description
1	SNDIF	I	Sound IF
2	AUDIOEXT	I	External Audio
3	NC		Not Connected
4	NC		Not Connected
5	PLLLF		IF-PLL loop filter
6	IFVO	O	IF-Video
7	SCL	I	Serial Clock
8	SDA	I/O	Serial data
9	DEC_{BG}		Bandgap de-coupling
10	CHROMA	I	Chrominance
11	CVBS/Y	I	External CVBS/Y
12	V_{P1}		Main supply voltage 1 (+8V)
13	$CVBS_{INT}$	I	Internal CVBS
14	GND 1		Ground 1
15	AUDIOOUT	O	Audio
16	SECPLL		SECAM PLL de-coupling
17	$CVBS_{EXT}$	I	External CVBS
18	BLKIN	I	Black-current
19	BO	O	Blue
20	GO	O	Green
21	RO	O	Red
22	BCLIN	I	Beam current limiter input/V-guard input
23	RI	I	Red input for insertion
24	GI	I	Green input for insertion
25	BI	I	Blue input for insertion
27	RGBIN	I	RGB insertion
27	LUMIN	I	Luminance
28	LUMOUT	O	Luminance
29	BYO	O	(B-Y) signal
30	RYO	O	(R-Y) signal
31	BYI	I	(B-Y) signal
32	RYI	I	(R-Y) signal
33	REFO	O	Sub-carrier reference
34	XTAL1		3.58MHz crystal connection
35	XTAL2		4.43/3.58MHz crystal connection
36	DET		Loop filter phase detector
37	V_{P2}		2nd supply voltage 1 (+8V)
38	CVBS1O	O	CVBS-1
39	DECDIG		De-coupling digital supply
40	HOUT	O	Horizontal
41	FBISO	I/O	Flyback input/sandcastle output
42	PH2LF		Phase-2 filter
43	PH1LF		Phase-1 filter
44	GND2		Ground 2
45	EWD	O	East-west drive
46	VDRB	O	Vertical drive B
47	VDRA	O	Vertical drive A
48	IFIN1	I	IF input 1
49I	FIN2	I	IF input 2
50	EHTO	I	EHT overvoltage protection
51	VSC		Vertical sawtooth capacitor
52	Iref	I	Reference current
53	DEC_{AGC}		AGC de-coupling capacitor
54	AGCOUT	O	Tuner AGC
55	AUDEEM		Audio de-emphasis
56	DECSDEM		De-coupling sound demodulator

TDA884X Pin Designations

REMOTE CONTROL

The remote control system used is the Philip's Enhanced RC5 protocol, with sub-address 00000.

10.1 Infra-red Transmitter

The hand unit is controlled by IC781, type PCA84C122AT/093, surface mounted on the keypad side of the PCB. When replacing the part, the /093 is significant as it determines the key codes transmitted. Two AA type batteries in series provide a 3V power supply.

The IC remains in standby mode (oscillator not running) until a key on the matrix is pressed. The oscillator, governed by a 4MHz ceramic resonator XL781 is started. The IC decodes the key with suitable debounce and then transmits the relevant code, repeating as per the RC5 specification until the key is released. The RC5 pulse train output is modulated within the IC onto a 33.33kHz (f.osc/1 20) carrier with low (1:3) hark:space ratio, reducing power consumption and allowing higher LED current. The output on pin 21 of IC781 drives TR781 which provides high current pulses through infra-red transmitter diode D781. Reservoir capacitor CE781 reduces momentary battery voltage drop which may otherwise affect the IC.

NB. Only complete Remote Control Hand Units are available as spares with the exception of the battery cover. Both replacement part numbers can be found in the parts list.

10.2 Infra-red Receiver

The chassis uses an integrated receiver, IC702, which provides a fully demodulated output to the microcontroller through R703, pulled up by R702.

Keypad N°	Symbol	Functions	Keypad N°	Symbol	Functions
1		Standby	16		Programme Up
	1	N° 1	17		Increase Volume
3	2	N° 2	18		Decrease Volume
4	3	N° 3	19		*Fastext (RED)
5	4	N° 4	20		Menu/*Fastext (GREEN)
6	5	N° 5	21		Menu/*Fastext YELLOW)
7	6	N° 6	22		Menu/*Fastext (CYAN)
8	7	N° 7	23		Normalize/*Hold
9	8	N° 8	24		*Expand
10	9	N° 9	25		*Reveal
11	0	N° 0	26		Status/*Fastext Index
12		TV	27		AV Select
13		*Text/*Mix	28		*Time/*Subcode
14		Programme Down	29		**Audio Select
15		Mute	30		*Update

* These functions are only present on chassis fitted with teletext
** These functions are only present on chassis fitted with stereo

Keypad Idents and Functions Table

MICROPROCESSOR CONTROL SYSTEM

11.1 Microcontroller

Micro-controller, I701, is either a 5AA5288 (on non-teletext sets) or a SAA5290 (on teletext sets). Both devices have integrated on-screen display (OSD) generator; the 5AA5290 also has an integrated teletext decoder. The micro-controller has a single 12MHz crystal X701. The television is controlled by serial (PC) bus communication, digital switching inputs and outputs, analogue-to-digital inputs and pulse-width-modulation (PWM) outputs.

11.2 Reset

At power on, C709 is not charged so the voltage on pin 43 of the micro-controller rises with the 5V supply and resets the micro-controller. An internal resistor to ground at this pin causes C709 to charge up and the voltage on the reset pin to drop to 0V.
In normal operation, transistor Q702 is switched on and the reset pin is low, but if the 10V supply voltage drops below about 8V the transistor will switch off and R721 will pull the reset pin high and reset the device.

11.3 User Control

User input is via infra-red remote control (Philips' RC5 protocol), internally decoded from the receiver I703, or from three (non-matrixed) local control keys on active low inputs, I701 pins 18, 19 and 20. The LED flashes each time a key is detected or remote command received.

11.4 Tuning

The tuning control voltage to the tuner is controlled via the PWM at pin 1 of I701 and integrating circuit around Q001. Minimum voltage is at maximum mark-space ratio (bottom of each band). Band-switching is controlled by active low outputs on pins 14, 15 and 16 (high, mid, low) and transistors Q002 to Q004. The controller makes AFC corrections by reading on-tune information from I501 via the I^2C bus.
As the tuner is controlled by voltage synthesis, there is no direct correlation between the controller output and the tuned frequency.

11.5 Non-volatile memory

The non-volatile memory, I702, holds configuration information, user settings, parameters as applicable for I^2C controlled ICs and the programme tuning records. It is itself accessed by I^2C. When a new memory IC is frtted, the microcontroller will automatically load default information, which takes a few seconds during power-up. Regular re-loading of the data, or corruption of settings may indicate I702 is faulty.

11.6 AV Switching

Inputs from pins 8 and 16 of SCART 1 are sampled by analogue to digital conversion on pins 9 and 10 of I701 respectively. The input levels are adjusted such that the controller will automatically switch to AV1 when pin 8 is above 6V and RGB when pin 16 is above 1V. The time constant on pin 16 ensures the controller will not detect real-time RGB insertion using pin 16.

11.7 OSD/Teletext

Line and field timings are obtained from V.sync on pin 37 and H.sync input on pin 36. Teletext (on teletext sets only) is obtained from the CVBS input on pin 23. The RGB outputs on pins 34, 33 and 32 respectively are inserted into the TV output when gated by the OSD EN OUT signal on pin 35. OSD / teletext contrast is controlled by the peak reference level on pin 31, generated from the microcontroller PWM output on pin 2 via Q305.

11.8 Error codes

Under the following fault conditions the television will switch to standby and flash the LED.

Fault Condition / No. of Flashes	
Multiple TDA884X I^2C errors	1
Over voltage / X-ray protection (OVP)	2
Line start-up sequence failed	3
Black current (BC) loop unstable	4
Vertical scan failure	5
Continuous TDA884X power-on reset	6

Multiple error codes may appear, eg. two quick flashes, pause, four quick flashes etc. for OVP + BC loop errors.

11.9 Adjustments

In order to make service adjustments including setting the height, width, various configuration options, etc., the TV should have a suitable signal tuned in; ideally, a geometry test card. A teletext signal is recommended for setting OSD contrast on a teletext chassis.

To enter service mode, place a shorting link across terminals 2 and 3 of P701.

In service mode, two 2-digit hexadecimal numbers are displayed to the left of the screen; the lefthand one is the service parameter number, tte righthand one is the value for that parameter. Some parameters are identified by a two-letter code instead of a number, see below.

For example:- 0A IF shows parameter ten (0A hex) at thirty-one (IF hex).

In this mode of operation some of the remote control keys have different functions;

The up and down and local select keys are used to select a parameter.
The remote and local left and right keys are used to change the value of the current parameter.
The TV button is used to store any changes.
The teletext select and digit '0' keys are used for programme up or down.
The Normalize key selects factory picture settings immediately over-writing user settings.
The digit keys '1', '2', ---- '8' toggle the state of the individual bits '7', '6', ---- '0' of the value of the current parameter, for example, pressing digit key '4' would change value 1F hex to 0F hex.

TO STORE THE CHANGES, PRESS THE TV KEY ON THE HAND UNIT BEFORE REMOVING THE SERVICE MODE LINK. THE MESSAGE 'STORED' WILL BE DISPLAYED TO CONFIRM THE OPERATION.

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Service Notes Cont'd

Under certain circumstances, for example abnormal operation due to suspected corruption of the service parameters, it may be necessary to perform a complete reset of the non-volatile memory (I702). To effect this, press and hold the X (teletext update) key for about 3 seconds or until the set switches to standby. Following this it will be necessary to perform a 'set-up' of the television.

11.10 Service Parameters

The following values assume you are watching a tuned in picture, on RF. (On other sources, or with no signal, some values may differ.)

Service parameters 00 to 1A apply to the control registers of I501 as shown in the following table.

No.	Value			Function	Action
	14"	20"	21"		
00	02	02	02	System control	Do not adjust
01	D0	D0	D0	System control	Do not adjust
02	1F	1F	1F	Hue (SCART NTSC 4.43 playback only)	Use picture menu control instead
03	20	1D	27	Horizontal shift	Adjust to centre picture horizontally
04-07	00	00	00	E-W control	Not used on this chassis
08	20	1F	1E	Vertical slope (linearity)	Adjust for vertical linearity
09	10	0B	1A	Height	Adjust for correct picture height
0A	44	4A	4A	S-correction	Adjust for best vertical S-correction
0B	2B	1B	1B	Vertical shift	Adjust to centre picture vertically
0C	29	36	3D	White point - Red	
0D	29	38	3D	White point - Green	See Adjustments
0E	29	38	3D	White point - Blue	
0F	1C	1C	1C	Peaking (sharpness)	Use picture menu control instead
10	5C	5C	5C	Brightness	Use picture menu control instead
11	9C	9C	9C	Saturation	Use picture menu control instead
12	1C	1C	1C	Contrast	Use picture menu control instead
13	13	13	13	AGC take-over point	See Adjustments
14	0A	0A	0A	Volume	
15	50	50	50	IF PLL adjustment	Set to 50 hex.
16	19	19	19	Vertical zoom	Not used on this chassis
17	20	20	20	Vertical scroll	Not used on this chassis
18	81	81	81	Control 2	Do not adjust
19	08	08	08	Control 3	Do not adjust
1A	00	00	00	Control 4	Do not adjust

Service Parameter Functions Table

Parameters above 1A are designated by two-letter codes (except text contrast on a teletext set). These control configuration.

Text Mode
Text (OSD) contrast Set as preferred, see notes below

Ex
Export (VHF/UHF) setting 00 for UHF-only, 01 if multi-band tuner

AV
AV socket configuration 00 single SCART, 01 single SCART plus phono inputs

It is advisable to make a note of the existing values prior to commencing servicing. (see "Adjustments")

11.11 Microcontroller Pin-outs

(See Next Table)

Pin Descriptions

11.12 SAA5290 (Teletext) & SAA5288 (Non-teletext) Microcontrollers

Note: The SAA5288 microcontroller used on non-teletext models does not perform the functions in the shaded area. (See Opposite)

Block Diagram

Microcontroller Pin-outs

Pin	*Designation*	*I/O*	*Purpose*
1	P2.0/TPWM	O	Tuning PWM
2	P2.1/PWM0	O	Text contrast PWM
3	P2.2/PWM1	O	AV audio control: high = AV2, low = RGB/AV1
4	P2.3/PWM2	O	*FM/AM source select (low = AM)
5	P2.4/PWM3	O	*SCART/internal sound select (low = internal sound)
6	P2.5/PWM4	O	*L' control select (active high)
7	P2.6/PWM5	O	Pseudo line drive
8	P2.7	O	Force RGB high = RGB mode
9	P3.0/ADC0		AV1 SCART pin 8 level detection (ADC)
10	P3.1/ADC1		AV1 SCART pin 16 level detection (ADC)
11	P3.2/ADC2		AGC level sampling (ADC)
12	P3.3		–
13	Vssd		Digital ground
14	P0.0	I	High band tuner select (active low)
15	P0.1	I	Mid band tuner select (active low)
16	P0.2	I	Low band tuner select (active low)
17	P0.3	O	Audio mute control (active low
18	P0.4	I	Select key
19	P0.5	I	Down key
20	P0.6	I	Up key
21	P0.7		–
22	Vssa		Analogue ground
23	CVBS0	I	Composite video
24	CVBS1		–
25	Black	I	Video black level storage
26	Iref	I	Reference current
27	Frame		–
28	Test		Ground
29	COR		–
30	P3.4		TDA884X Line drive gating: high in standby & start-up, low in operation
31	RGBref	I	RGB reference
32	OSD B	O	Blue OSD
33	OSD G	O	Green OSD
34	OSD R	O	Red OSD
35	OSD EN	O	OSD enable
36	H sync	I	Horizontal sync
37	V sync	I	Vertical sync
38	Vdda		+5V display power supply
39	Vddt		+5V display power supply
40	Osc gnd		Crystal oscillator ground
41	Osc in	I	12MHz crystal oscillator
42	Osc out	O	12MHz crystal oscillator
43	Reset	I	Reset (active high)
44	Vddm		+5V microcontroller power supply
45	P1.0/Int1	I	Remote control
46	P1.1/T0	O	Standby/IR LED: low = LED bright, high = LED dim
47	P1.2/Int0	I	Line drive from TDA884x
48	P1.3/T1	O	Standby control (active low)
49	P1.6/SCL		I²C clock
50	P1.7/SDA		I²C data
51	P1.4	I	Service mode (active low)
52	P1.5	I	Halt microcontroller control (active low)
NOTE	*		***Only used on French chassis***

Pin Descriptions Table

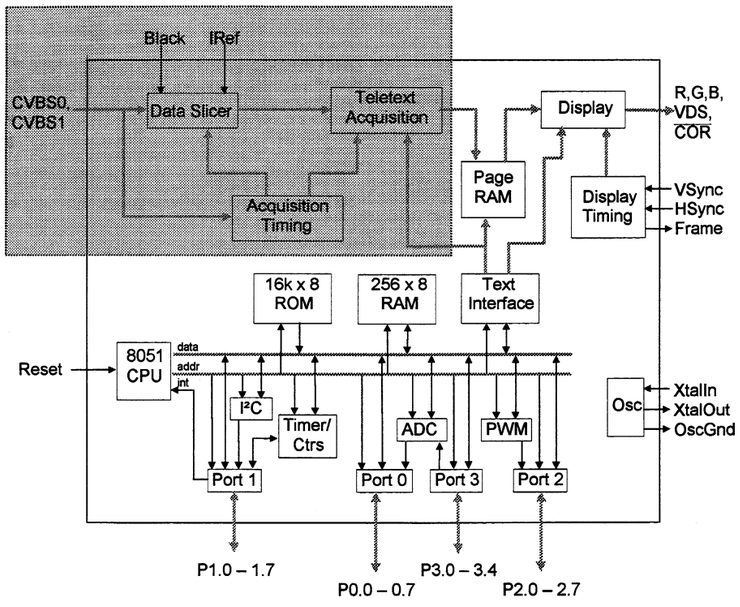
Adjustments

12.1 H. T. Setting

The HT should be adjusted using R818 to obtain correct width with normal brightness and contrast settings. A Philips complex test pattern is ideal for the operation.

12.2 AI Control

This should be set using the 'screen control on T401 to achieve 140V black level at the tube base cathodes with the brightness and contrast settings normalized. In practice the black level of the individual guns will differ and are set by 501 to achieve equal cut-off points..



12.3 White Points

These should be adjusted via service parameters 0C, 0D and CE whilst viewing a picture with little light area to prevent beam current limiting. The parameters should be adjusted for a black to white swing of 50V ±1V (14'), 55V ±lV (20') or 60V ±1V (21') on each of the three cathodes with the picture normalized.

12.4 Text Contrast

White balancing of the red and blue outputs, relative to the green, should be carried out to ensure pure white text, using RV317 (R) and RV319 (B). As the picture outputs are automatically balanced, text white may be set using picture white as a reference once the black and white points (sections 12.2 and 12.3) have been set. The text contrast itself should be adjusted such, that the Text/OSD white parts are approximately 75% of the intensity of a test pattern peak white area: this corresponds to the 75% grey blocks in part of a 'Philips 5544' type test pattern. When the text contrast service parameter is selected the TV switches to teletext mix mode, page 101. If no text is present P100 will still appear in the top left corner of the screen together with some text on the bottom row of the display. There is no on-screen parameter adjust with volume control as normal and change parameter with programme up/down keys.

12.5 AGC

The AGC take-over point should be adjusted via service parameter 13 such, that the tuner output to the SAW filter is 600mV pk-pk (300mV per side for symmetrical tuner output) using a test pattern with no sound carrier.

12.6 Focus

Adjust the upper control on the rear of the flyback transformer for best focus.

12.7 Positioning

Horizontal position should be adjusted via service parameter 03 so as to centre the picture. Vertical position should be adjusted via service parameter 0B so as to centre the picture. This may be simplified by pressing '1' with service parameter 08 selected to activate service blanking which blanks the lower half of the picture. The edge of the blanked area may then be aligned with the tube centre marks. Service blanking is disabled by once again pressing the '1' key.

12.8 Linearity

Horizontal linearity is fixed; no adjustment is possible. Vertical linearity is adjusted using service parameters 08 and 0A (linearity and S-correction) whilst displaying a cross hatch pattern. Adjust the linearity for evenly spaced intervals at the top and bottom of the picture, then adjust the S-correction to achieve equal spacing accross the whole screen.

12.9 Vertical Protection Disable

Vertical protection is used to shut down the chassis in the event of field-scan failure. For diagnostic purposes this can be disabled by selecting service parameter OA (S-correction) and pressing the number 2 key on the hand unit. After repair, vertical protection should always be re-enabled by pressing the number 2 key again and storing it with the TV key. (The value of parameter OA toggles between two values when the number 2 key is pressed, the higher of which indicates that the vertical protection is enabled.).

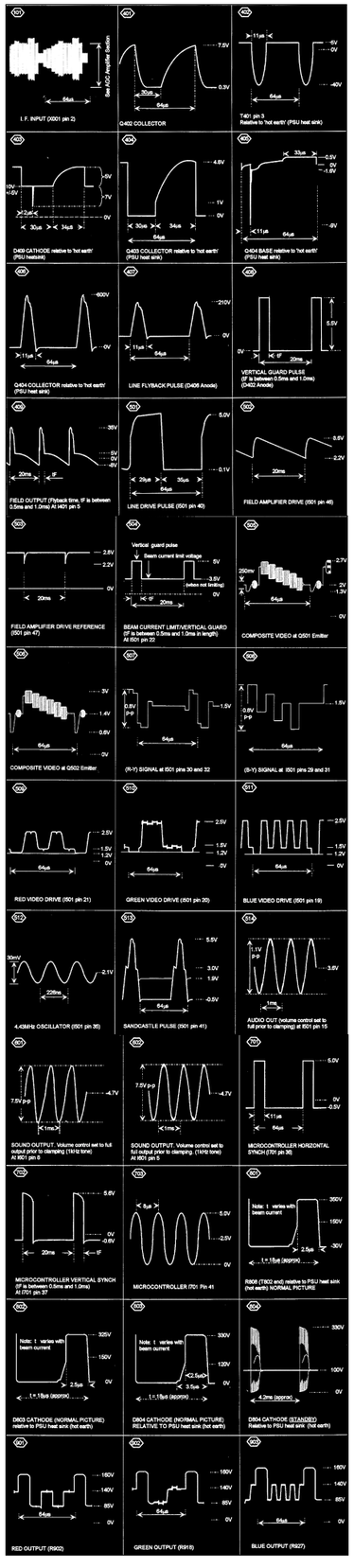
12.10 Auto Black Level Disable

I501 independently sets the black level of each CRT gun to equalize the cut-off points and therefore provide a true black.
For diagnostic purposes this control loop may be disabled by selecting service parameter 02 (hue) and pressing the number 2 key on the hand unit. After repair, the auto black level sampling should always be re-enabled by pressing the number 2 key again and storing it with the TV key. (The value of parameter 02 toggles between two values when the number 2 key is pressed, the lower of which indicates black level sampling is enabled.).

Main Diagram Notes

Safety and isolation
The power supply and line output stage are always live regardless of the mains supply polarity, therefore, for servicing, the receiver should be supplied through a mains isolation transformer.
The power supply remains charged for approximately 30 seconds after switching off. Avoid touching this area during this time.
Most of the receiver, other than the power supply and line output stage, is isolatedfrom the mains by T401, I402, T802, R804, R805, C804 and an air gap of 6mm or more built into the chassis and deflection yoke. To maintain safety, ensure that after the repair the air gaps are not reduced by protruding wires etc.

Main Diagram Waveforms



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