Operating principle of CDP 15H / 17L

I. General specification

Inch	Model	CRT	Frequency	Maximum resolution
15"	550b : SyncMaster 55B : Samtron	SDD 15" TSB 15"	Hori. : 30 ~ 70. Vert. : 50 ~ 160.	1024 * 768 / 85.
17"	750s : SyncMaster 75E : Samtron	SDD 17" TSB 17"	Hori. : 30 ~ 70. Vert. : 50 ~ 160.	1024 * 768 / 85.

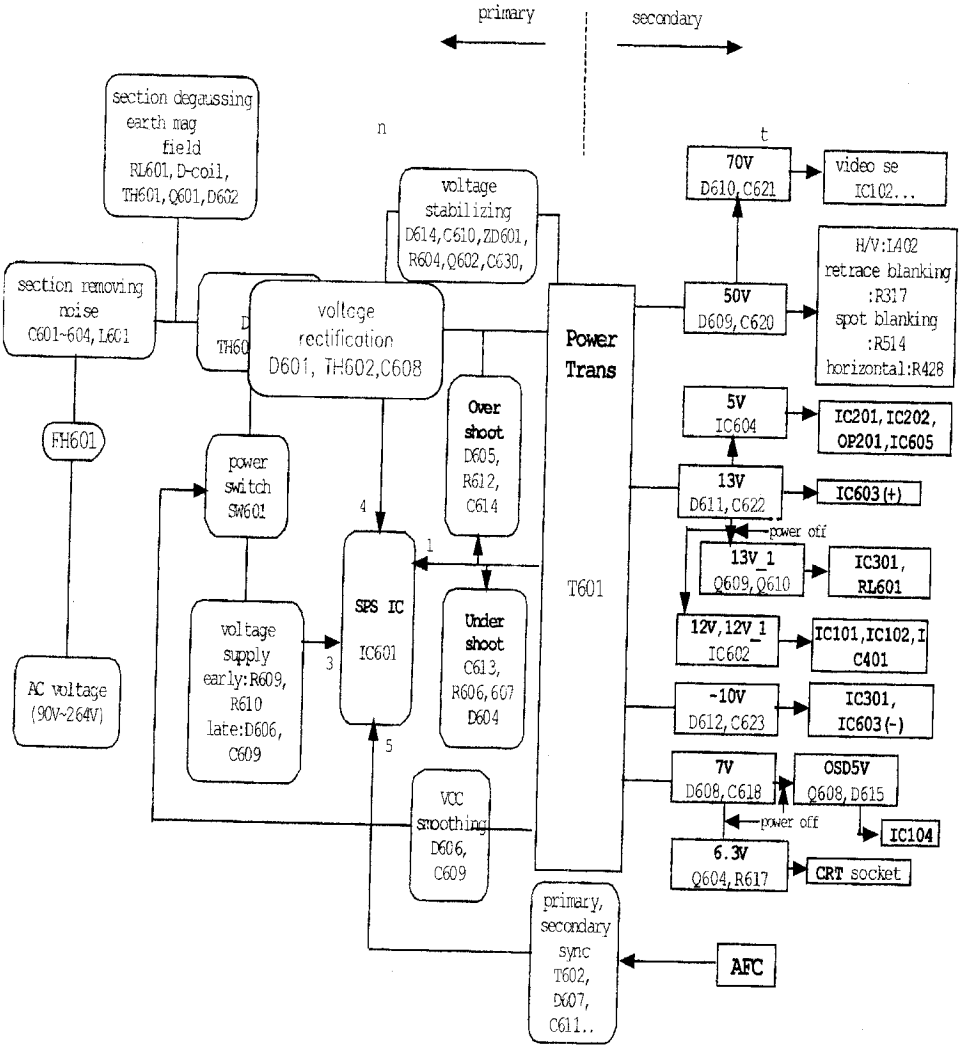
1. Important blocks on a circuit
   1) Power block (IC601 : DP104C)
   2) Micom block (IC201 : KS88C6232N)
   3) Vertical block (IC301 : KA2142)
   4) Horizontal block (IC401 : TDA4859, Q402 : KSC5802, D407 : DTV56F)
   5) High voltage block (T501 : SAMPO, SEMCO FBT)
   6) Video block (IC101 : KA2506, IC102 : LM2439, IC104 : KA2501-09)

2. Major difference between CHB circuit and DP circuit
   1) Productivity improved
      : Automating the adjustment process through I^2C method.
      - automating the image adjusting process
      - automating the color adjusting process
      - automating the process adjusting horizontal size to the minimum.
      - automating the ACL adjusting process
      - eliminating FBT B+ VR
      - eliminating power B+ VR

      : Promoting common use of the chassis for 15", 17" and 17" multimedia model.
   2) the number of parts reduced
   3) Localization for major parts like IC601, IC101, IC201 and promoting cost reduction
   4) Reducing the power consumption of standby mode (from 5W to 3W)
      : The actual power consumption is 2.0W to 2.5W.

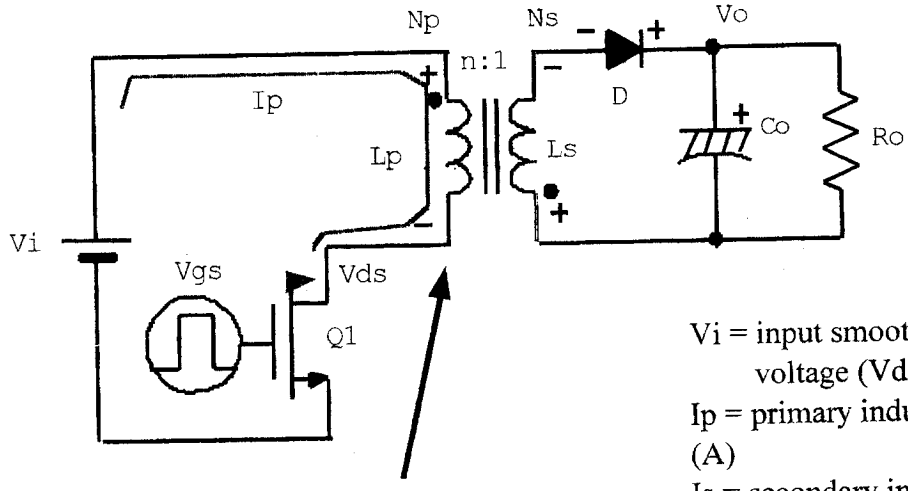
1. Power circuit

1-1. Block diagram



[Schematic diagram for monitor power]

1-2. Basic operating principle of flyback converter



Save energy at Lp.
$P=\frac{1}{2} \times L \times I^2$

Vi = input smoothing condenser voltage (Vdc)
Ip = primary inductance current (A)
Is = secondary inductance current (A)
Np = number of primary winding (Turns)
Ns = number of secondary winding (Turns)
n = winding ratio between Np and Ns
Lp = primary inductance (uH)
Ls = secondary inductance (uH)
Q1 = switching FET
Vgs = FET gate voltage (V)
Vds = voltage between FET drain and source (V)
D = output switching diode
Vo = output voltage (Vdc)
Co = output condenser (uF)
Ro = output load resistance (monitor load)

Figure 1. Flyback converter circuit operation (section t1)

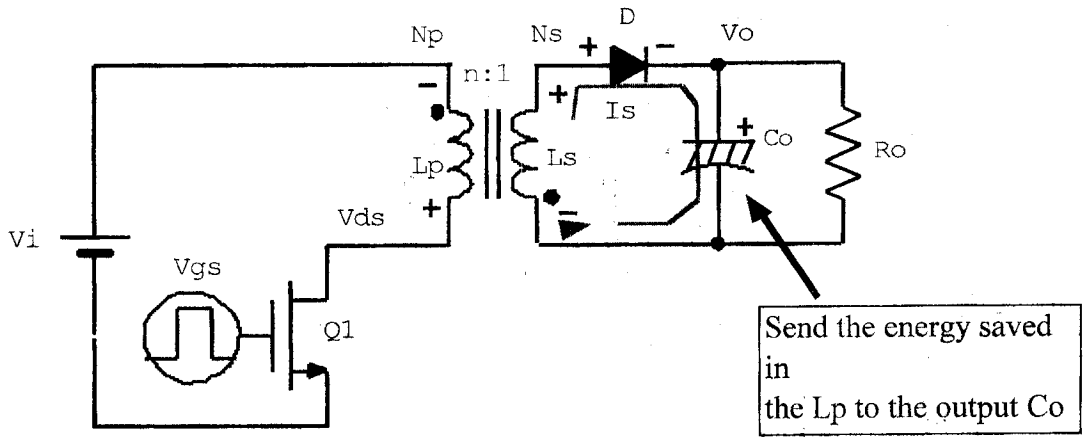
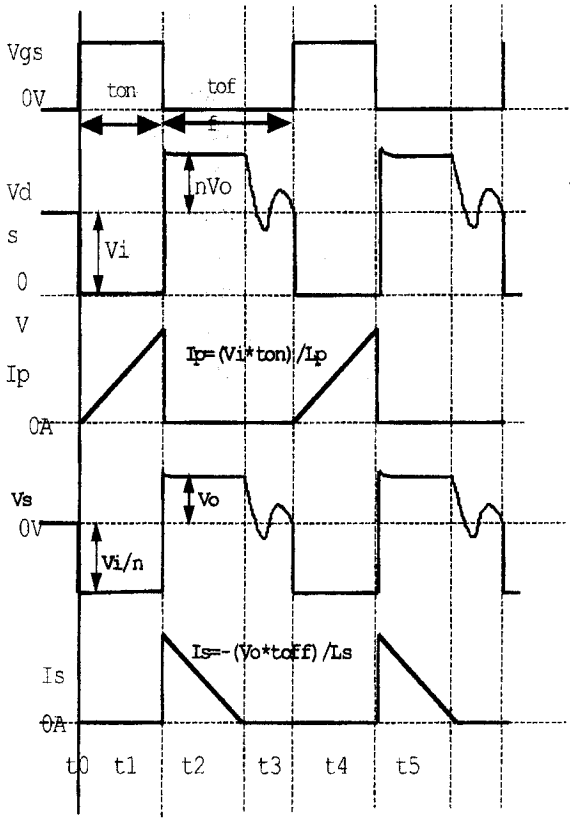


Figure 2. Flyback converter circuit operation (section t2)

Flyback converter is the circuit used mainly for monitors under 120W.
It is on-off type converter circuit, which saves energy at Lp when FET (Q1) is on and transfers the energy to output when FET (Q1) is off.
The basic operational characteristics are as follows.



[Flyback converter waveform]

Vi(dc)=Vin(ac) ¿ ‡ 2¿ 0.9[Vdc]

$$P = \frac{1}{2} L \bullet I^2 [J]$$

$$P = \frac{1}{2} Lp \bullet Ip^2 \bullet f [W]$$

$$= \frac{1}{Lp} (Vi \bullet ton) [A]$$

P[J] = Å ¿
P[W] = Ò fi i
W=
Ip = 1Â Ã
Is = 2Â Ã
ton = Turn-(
toff = Turn
T = Ä â (
f = ½ À

P[J] = work or energy (joule)
P[W] = power dissipation (watt)
W = joule/sec.
Ip = primary inductance current (A)
Is = secondary inductance current (A)
ton = Turn-On Time (sec.)
toff = Turn-Off Time (sec.)
T = period (T = ton + toff)
f = switching frequency (kHz)

(1) section t 1 (= ton)

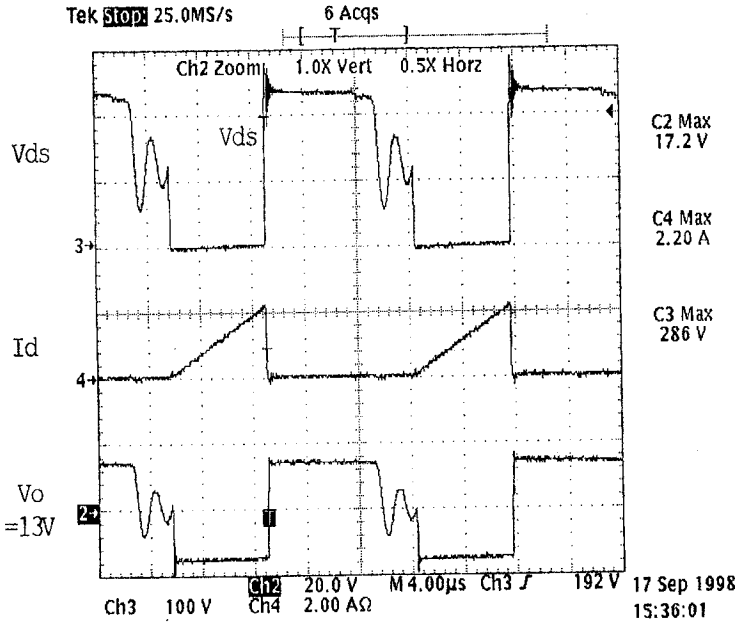
1) If about 10V is applied to the gate (Vgs) of Q1 (FET), the Vds voltage becomes zero because Q1 turns on and Ip current flows while Vi voltage is charged in Lp.
2) If the current flows like this, Ip = (Vi * ton)/Lp, the energy of $1/2Lp*Ip^2$ [J] is charged to Lp. In this case, Is current can't flow in the secondary Ns because the voltage is applied to the diode in reverse direction.

(2) section t 2

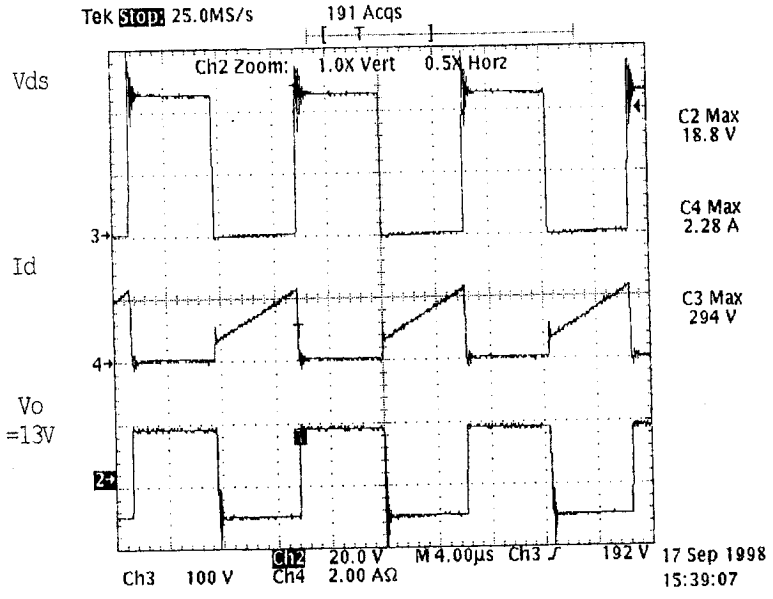
1) The moment Vgs is zero, Q1 turns off and Ip current does not flow. Due to the inductor characteristic that intends to maintain the previous magnetic flux, back electromotive force is generated and the polarity of Np is changed.
2) As the polarity of Np is changed, the diode turns on in forward direction and Is current is decreased. Therefore, the Vo voltage is charged to Co.
3) In other words, the inductor energy saved in Lp ($1/2Lp*Ip^2$) moves to Co with the formula of $1/2Co*Vo^2$.

(3) section t 3

1) If all the energy saved in the primary is transferred to the secondary, the Is current becomes 0A and there is no longer current flowing in the secondary.
2) In this section, the energy that has been charged in hundreds of pF Coss resonates over Lp inductor and is decreased through resistor (R606, R607).
(Coss = output diode distributed capacitor + Q1 inside capacitor + snubber capacitor)
(fo = 1/(2..(Lp*Coss).)



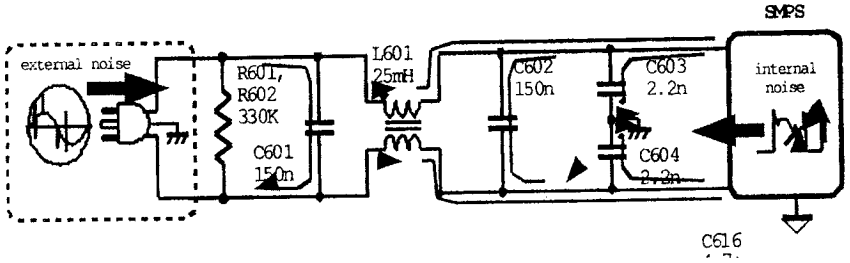
[Actual waveforms (56./AC90V)]



If switching frequency goes up, Ip is getting small.

[Actual waveforms (82./AC90V)]

1-3. Noise filter circuit



R601, R602 : Discharging resistor across C601 (X-capacitor)
C601, C602 : X-capacitor (for normal mode noise filter)
L601 : Line filter (for C/mode noise filter)
C603, C604 : Y-capacitor (for C/mode noise filter)
C616, C617 : Y-capacitor (for C/mode noise filter)
* Normal mode noise : Noise that exists between live and neutral line.
Common mode noise : Noise that exists between live, neutral and ground.

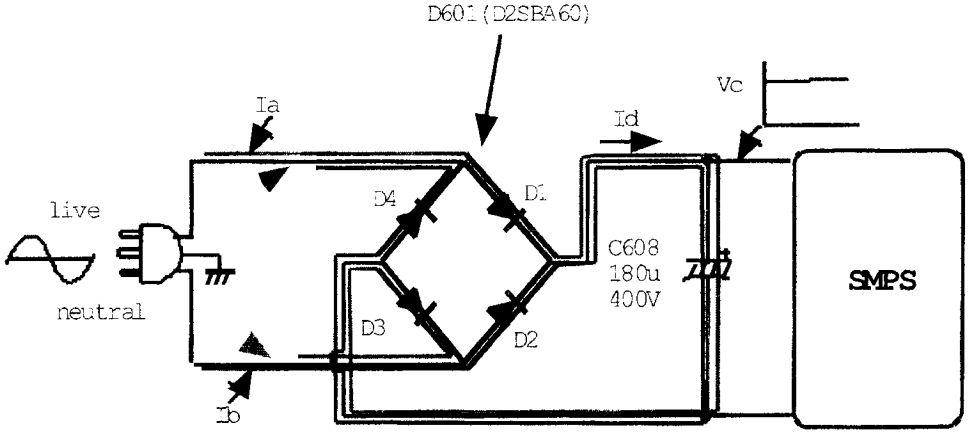
[Noise filter circuit]

Noise filter

There are a lot of circuits operating in the monitor circuit. Especially SMPS circuit which provides power supply produces a lot of switching noise because it switches high voltage to high current. If this noise goes out through power line, it causes malfunction or breakdown of other devices. Therefore the noise should be eliminated by using noise filter circuit.

1) X-capacitor : C601, C602
It is used to eliminate the normal mode noise made between the live and the natural of power supply.
2) Y-capacitor : C603, C604
It is used to bypass the common mode noise that flows in live-ground and natural-ground. It makes high frequency noise bypass.
3) Y-capacitor : C616, C617
It is used to bypass the noise that occurs in hot-ground to the chassis-ground.
4) Line-filter : L601
It has characteristic that restrains the noise flowing in common mode from going out or coming in, using the principle that impedance increases according to frequency.
5) Discharge resistor
Even though a user pulls a plug out of the socket, there is potential electric shock because the charged AC input voltage still remains in the X-capacitor.
To prevent the electric shock, the discharge resistor is used.
6) When using major components like X-capacitor, Y-capacitor, fuse, etc., which are used for the power line of monitor circuit, be sure to use the components that have obtained the safety regulation approval.

1-4. Rectifier circuit



[Schematic diagram for rectifier circuit]

Rectifier circuit is the circuit for converting AC voltage into DC voltage.
It is used to exclude the AC ripple from the DC output voltage, which is supplied to the monitor circuit, and make the SMPS operation stable.
(1) Section t 1
1) The sine wave voltage at the live of AC input increases in + direction and rises.
2) As the input voltage of the live is lower than the Vc voltage of smoothing condenser (C608:180uF), the reverse voltage applies to the rectifier diode D1, D3 and the current (la) does not flow.

(2) Section t 2

1) As soon as sine wave voltage at live of AC input is higher by 1.4V than the Vc voltage, D1 and D3 turn on in forward direction. The Ia current flows according to the following directions. Live . D1 . C608 . D3 . Neutral

2) This Ia current rapidly charges the Vc voltage of C608 up to Vc=Vac(rms)*.2.

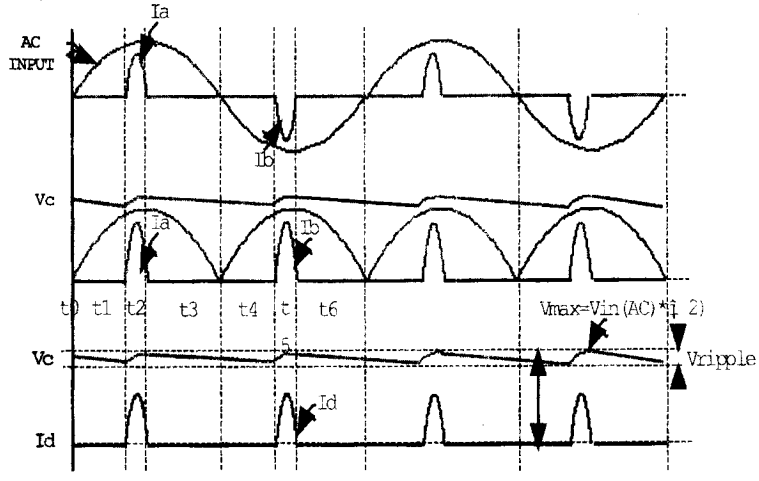
(3) Section 3

1) The AC input voltage of the live slowly drops to zero after reaching the Vmax. In this case, Vc voltage is getting higher than input voltage and the reverse voltage applies to the D1, D3 and the current does not flow.

(4) Section 4

1) The sine wave voltage of neutral of AC input increases in opposite direction and rises.

2) As the input voltage of neutral is lower than the Vc voltage of smoothing condenser (C608:180uF), the reverse voltage applies to the rectifier diode D2, D4 and the current (Ib) does not flow.



[Full-wave rectifier circuit]

(5) Section t 5

1) As soon as sine wave voltage at neutral of AC input is higher by 1.4V than Vc voltage, D2, D4 turn on in forward direction. The Ib current flows according to the following directions. Neutral . D2 . C608 . D4 . Live

2) This Ib current rapidly charges the Vc voltage of C608 up to Vc=Vac(rms)*.2.

(6) Section t 6

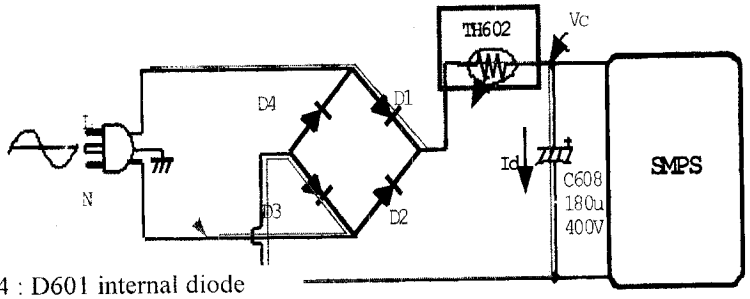
1) The AC input voltage of the live slowly drops to zero after reaching the Vmax. In this case, Vc voltage is getting higher than input voltage and the reverse voltage applies to the D2, D4 and the current (Ib) does not flow.

(7) Section t 3 - t 4

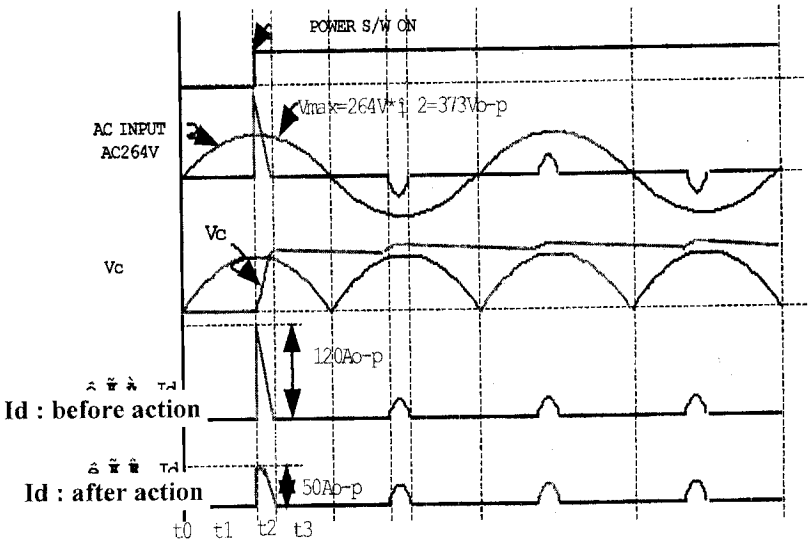
1) As there is no current charged from the input at the section t 3 and t 4, the current is used in the monitor load with the voltage charged in Vc.
Therefore Vc voltage gets decreased slowly

2) Therefore, Vripple always occurs in the Vc. If there is a lot of load current, the ripple will be bigger.

1-5. Inrush-current protective circuit



D1~4 : D601 internal diode
C608 : smoothing condenser
TH602 : thermistor (NTC)



Inrush current protective circuit

When the monitor power is on, the initial voltage of smoothing condenser (C608) is zero (t 2 = 0 volt). Since the Vc voltage of smoothing condenser rises up to the peak of AC input voltage, the inrush current flows. But this inrush current may destroy fuse or rectifier diode. NTC (Negative Thermal-coefficient Component), a current-limiting component is used to limit the current.

1) Section t 0 - t 1

Since the power switch is off, the Vc is zero and the current does not flow.

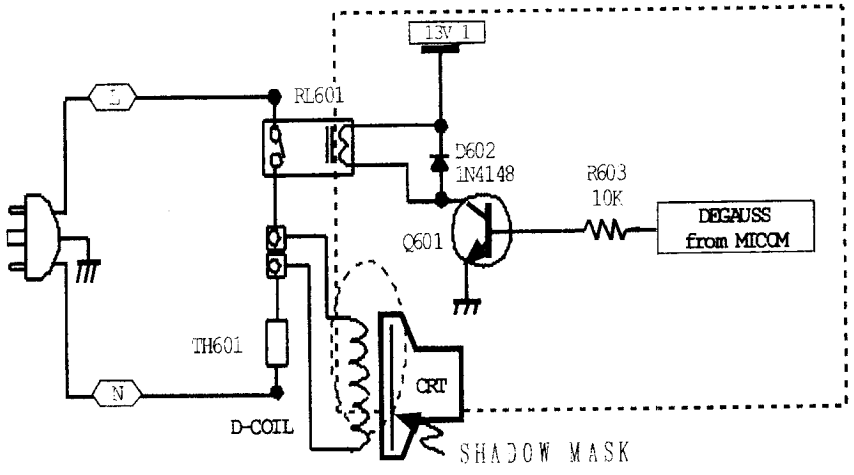
2) Section t 2

As the power is on when the Vc is zero, the Id current flows according to the following sequence, Live-D1-TH602-C608-D3 and C608 is charged until its Vc gets maximum. TH602 can limit the inrush current as it has about 8. at normal temperature (25.). As the current flows, the temperature of TH602 increases, while the resistance decreases. (Refer to the graph below.)

* Temperature and resistance graph for NTC

3) The inrush current occurs only when the power is on for the first time. If the Vc voltage is stable, inrush current does not occur.

1-6. Degaussing circuit



RL601 : Relay
TH601 : PTC (Positive Thermal-coefficient Component) posistor
D-coil : Degaussing coil
D602 : Q601 protective diode
Q601 : Relay on/off control TR
R603 : Q601 base current-limiting resistor

[Degaussing circuit]

Electron is emitted from the CRT cathode. The vertical and horizontal current flowing in DY makes the electron curved. If the electron hits the fluorescent screen through shadow mask, it emits light for a moment. Monitor can show the screen by using this principle.

Operating principle of CDP 15H / 17L

The monitor changes the direction of vertical and horizontal current so that the emitted electron can be scanned from the upper left and right to the lower of the screen.
The shadow mask placed in front of the CRT is made of metallic substance, so it is easily affected by external magnetic field or electric field. If there is strong high voltage around the monitor, it affects the electromagnetic field and causes the stain on the screen because electron can not be assigned to the correct position. This electron is affected by magnetic field as well as electromagnetic field. That's why severe stain occurs on the screen when magnetic is approached to the monitor when in use. There is a kind of magnetic field on Earth, which is toward the Antarctic from the Arctic. This is called Earth magnetic field. Monitors are also affected by this Earth magnetic field. If you swivel or tilt a monitor severely after the power is on, you can see stain on the monitor screen. That's because the monitor is affected by Earth magnetic field. The CRT affected by surrounding electro-magnetic field and Earth magnetic field prevents electrons from reaching their right course by making the electron alignment irregular. This makes the stain on the screen severer. To remove the stain on the screen, D-coil has to be placed around the CRT so that the D-coil can degauss the shadow mask by forming strong electric field.

(1) Operating principle

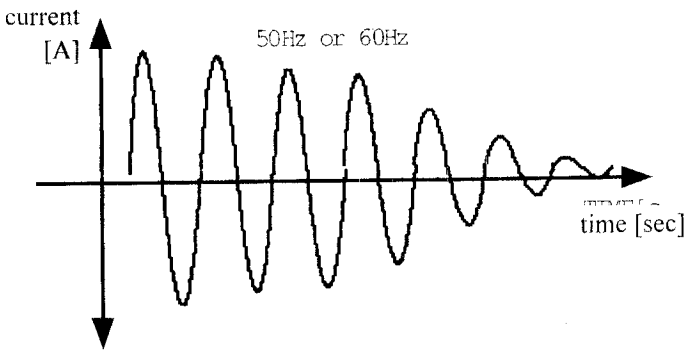
1) If power is on, "degauss control terminal of micom" turns on Q601 to provide high voltage for three seconds or longer.

2) If the collector and emitter of Q601 are shorted, the current flows on the internal coil of the relay (RL601) and the relay is shorted. The voltage is applied to the following sequence, Live - RL601 - D coil - TH601 - Natural and alternating current of sine wave begins to flow.

3) PTC (TH601) has the following resistance characteristics.
As time goes by, the current that flows on the D-coil is slowly decreased and nearly zero because the resistance is increased rapidly as the temperature rises.

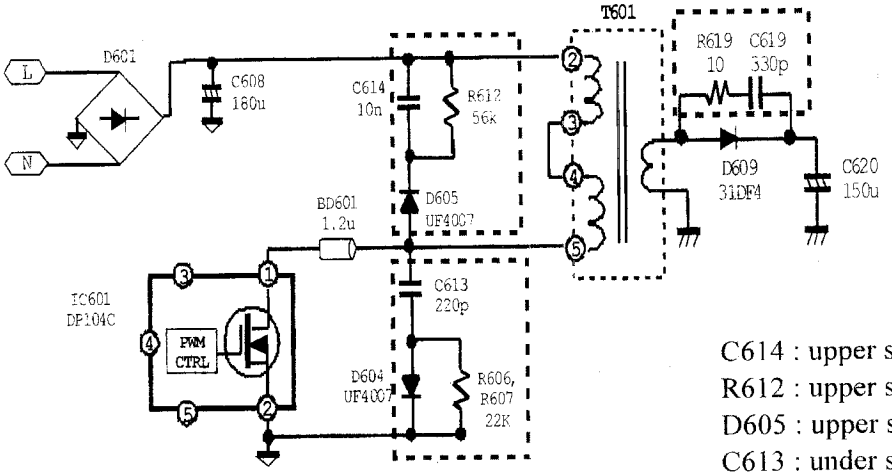
4) If more than 3 seconds elapse, the current does not flow any more because Q601 is turned off and the relay is open.

[Temperature and resistance characteristics of PTC degauss]



[Degaussing current waveform]

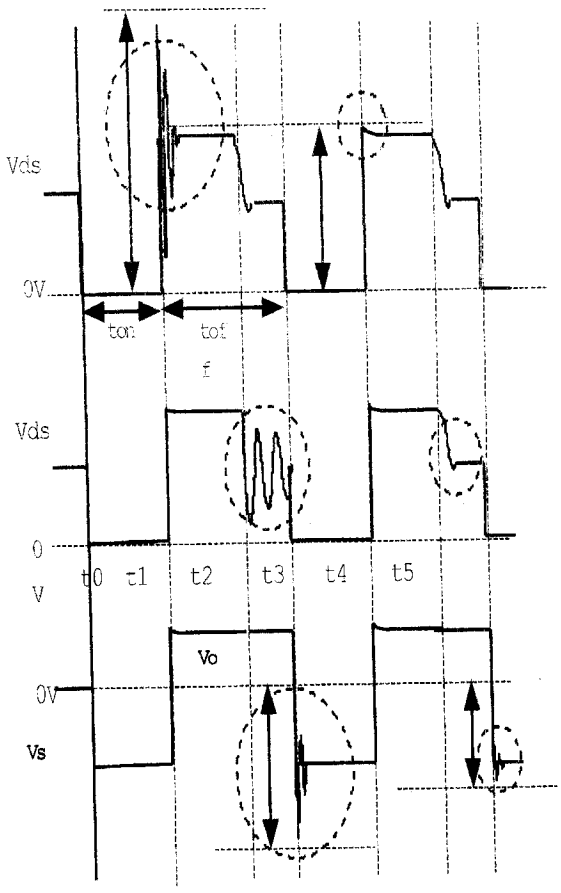
1-7. Snubber circuit



D601 : rectifier diode
C608 : input smoothing condenser
IC601 : power-IC
BD601 : bead-core for removing noise

C614 : upper snubber condenser
R612 : upper snubber resistor
D605 : upper snubber diode
C613 : under snubber condenser
D604 : under snubber diode
R606, 607 : under snubber resistor
T601 : power-trans
D609 : 50V output switching diode
R619 : output diode snubber resistor
C619 : output diode snubber condenser

Operating principle of CDP 15H / 17L



(1) Upper RCD snubber circuit
(C614, R612, D605)

1) At the time of toff, surge voltage that occurs in p/trans increases rapidly and exceeds Vds rating of FET and destroys IC601.
2) To prevent the destruction of FET by high surge voltage, charge the surge voltage with C614 through D605 and discharge it through R612.

(2) Under RCD snubber circuit
(C613, R606//R607)

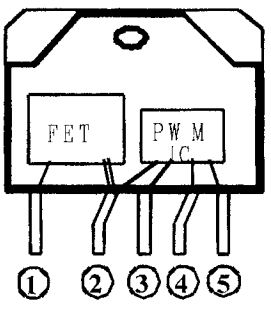
1) At the time of toff, charge Vds voltage with C613 capacitor to delay dv / dt. It plays as a snubber.
2) It also reduces the switching noise caused by resonance waveform. (section t 3)

(3) RC snubber circuit for protecting diode

1) The moment D609 is off at section t 4, surge voltage occurs in D609. Decrease the surge voltage and protect D609 by charging the surge voltage with C619 through R619.

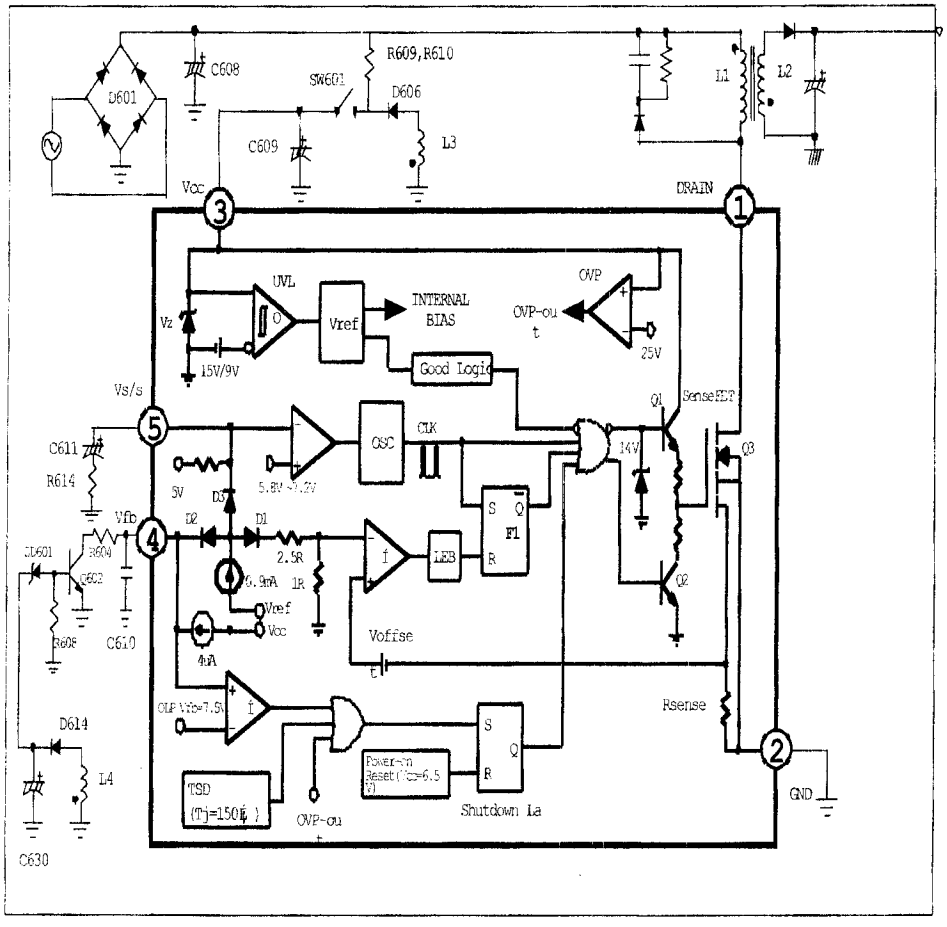
1-8. SPS-IC (DP 104C) configuration and operating principle

SPS (Samsung Power Switch) - IC is the power IC that has the functions of both control IC and FET in the form of 2 chip 1 package. The control IC has the functions of PWM (Pulse Width Modulation) and protective circuit, while FET has switching function. The functions of SPS - IC are as follows.



1 : DRAIN
2 : GND
3 : Vcc & OVP
4 : Vf/b & OCP
5 : Soft Sta & Sync

[SPS [Structure of SPS-IC package]

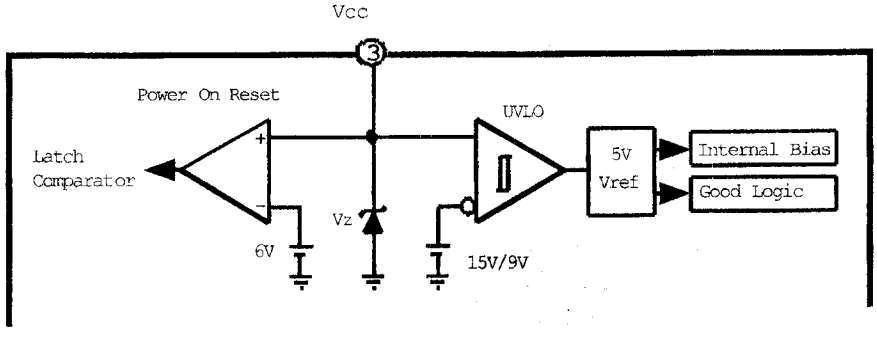


[SPS-IC internal block diagram]

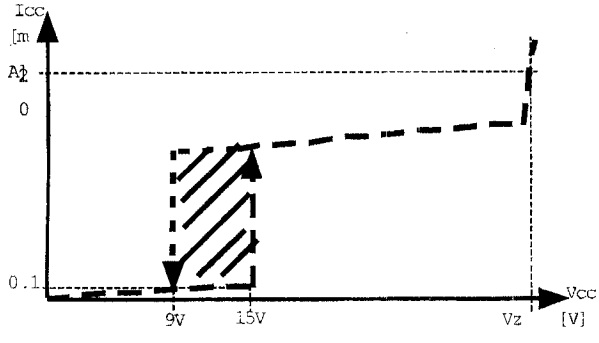
1-8-1. Operating principle of Start circuit

* Start up

It has the structure to drive the control IC of SPS and is designed for low start up current. It consists of "under voltage lock out" (UVLO) protecting low voltage state, 5V reference (Vref) supplying bias voltage to control circuit after "start threshold voltage" and 32V zener diode (Vz) limiting input power supply.
UVLO begins to operate at 15V. After power is on, its hysteresis characteristics appears between 6V and 9V. The starting resistance whose current is typically 0.1 mA is needed for the start up threshold voltage in order to minimize the power loss.
Vref has been designed for bandgap reference whose temperature characteristic is good and supplies the power to all kinds of SPS circuits except UVLO circuit and power on reset circuit. 32V Vz is used to limit the voltage between Vcc and ground in order to prevent IC hi-pot destruction or forcible operation, which occurs when the power Vcc of IC rises excessively. If the Vcc voltage is higher than Vz voltage, the current flows in zener diode.
Power on reset circuit is the circuit for resetting shutdown circuit. It outputs signal when Vcc is 6.5V or less. This circuit is supplied with bias voltage that has nothing to do with UVLO operation. Good logic signal is operated by UVLO.
It operates the output drive circuit at low or discharges the soft start capacitor or feedback capacitor.



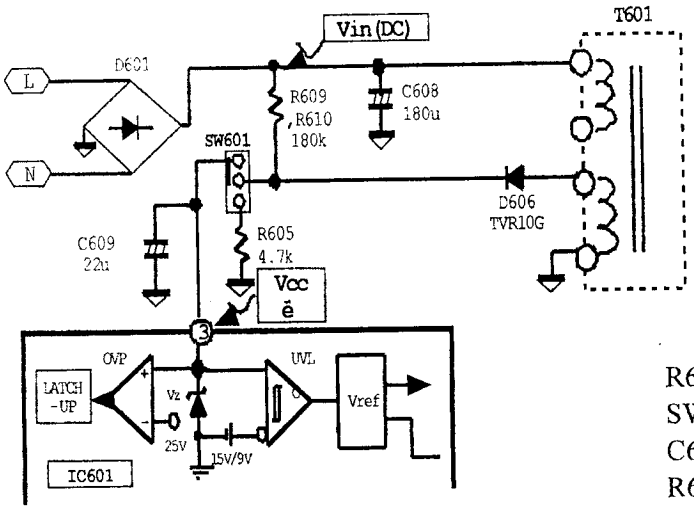
[Low current start up & Power on reset circuit]



Why does it operate at 15V or higher and stop at 9V?
It takes sub winding voltage 40ms to reach the normal voltage after switching. If the power IC stops operating during this time, it doesn't start up. Therefore, if there is no UVLO function, power IC does not operate normally.
normally.

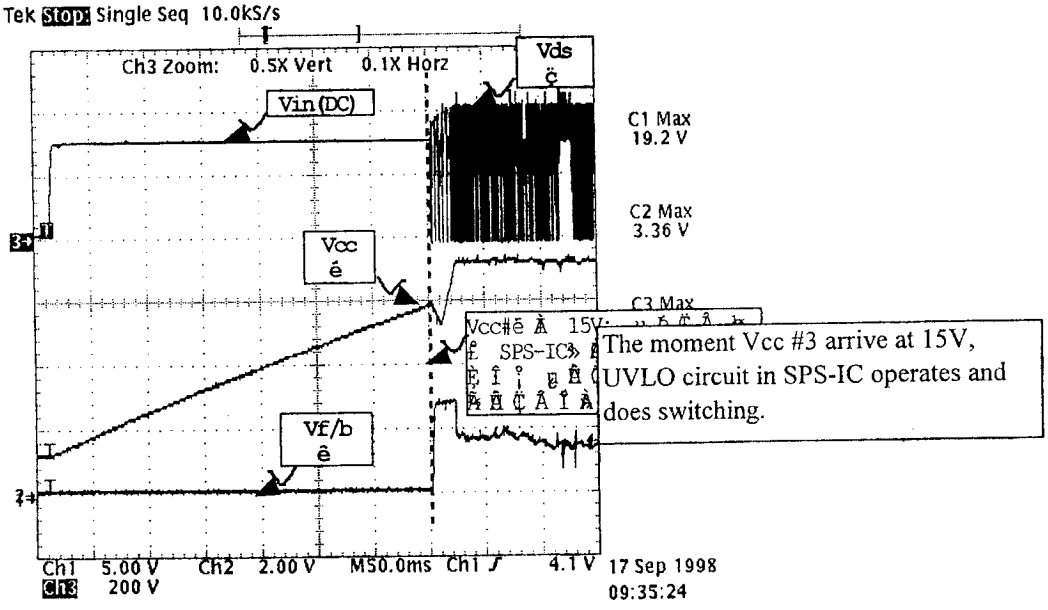
[Start up & power on reset circuit characteristics]

[Start actual circuit]



R609, R610 : start resistor
SW601 : power switch
C608 : smoothing condenser
R605 : protective resistor
C609 : Vcc supply condenser
D606 : switching diode

1) When SW601 is off, D606 voltage is maintained at less than 5Vdc due to the divided voltage like R609+R610 and R605.
2) If SW601 is on, the starting current flows on R609 and R610 connected to the Vin (DC) voltage and C609 (22u) is slowly charged. So Vcc voltage begins to rise as shown below.
3) The moment Vcc (#3) voltage reaches 15V, UVLO of IC601 operates and begins to do switching. Switching current flows over D606 of sub winding and it makes C609 voltage rise to 18~19Vdc. Therefore, normal operation voltage is maintained.



[Start operation waveform]

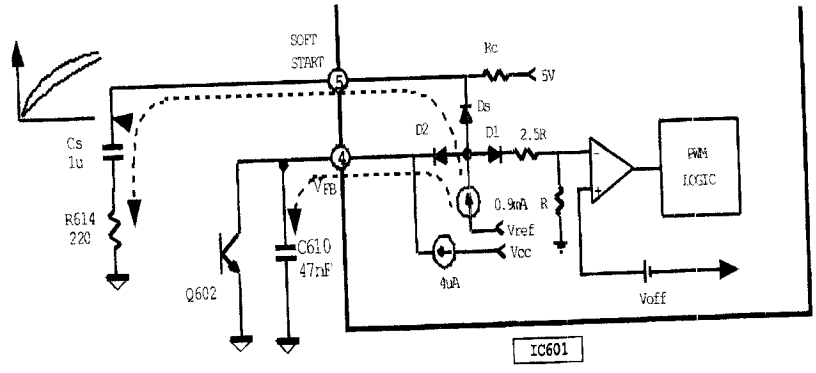
1-8-2. Soft start circuit

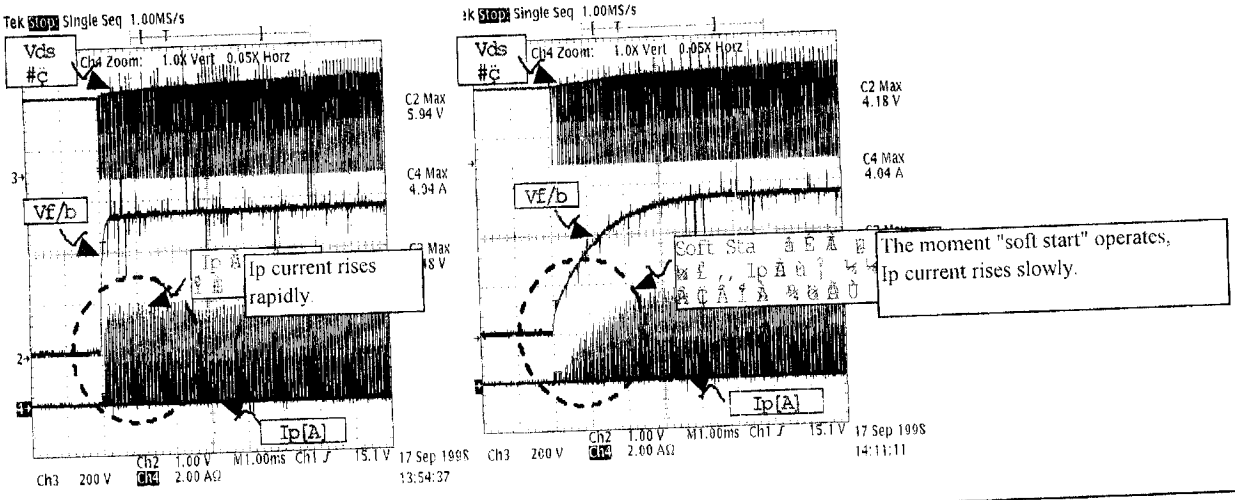
* Soft start

If the power of the monitor is on, 3.15 volt is applied to the C610 at rapid speed, while 0.9 volt is applied to "-" terminal of comparator. As 0.9 volt is the maximum current limiting level, it means the most current flows there. Since the peak value of drain current is maintained at its maximum, the maximum power is delivered to the secondary load from the beginning. If the maximum power is delivered to the secondary load on SMPS circuit from the beginning, the whole circuit is under severe stress. To remove this stress, "soft start function" is needed along with the presence of Ds and Cs. The charging speed of Cs is slower than that of C610 because the charging capacity of Cs is bigger than that of C610. (Cs : 1uF, C610 : 47nF) If the power of the monitor is on, voltage is applied to Cs (C611) through D2 and Ds. As the charging speed of Cs is very slow, the anode voltage of D1, D2 and Ds slowly increase to +0.7V of Cs and "-" terminal voltage of PWM logic slowly increases to the potential of Cs/3.15. It makes the rising speed of current limiting voltage slow and makes "duty" slowly increase. After all, the peak value of Q3 drain current is limited by Cs potential. It makes the output voltage rise gently.

If the Cs potential is 3.15V or higher, the Ds is off and the inverting terminal voltage is no longer decided by Cs potential. It depends on the feedback signal of output voltage.

The Cs is charged up to 5V through Rc. The soft start capacitor Cs is discharged according to the UVLO good logic operation, so the soft start is repeated during re-operation.



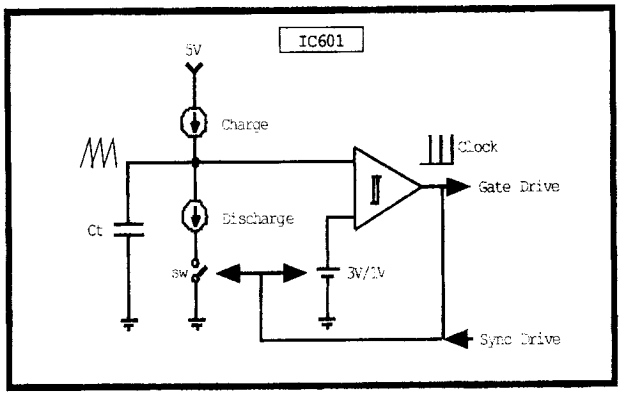


1-8-3. OSC

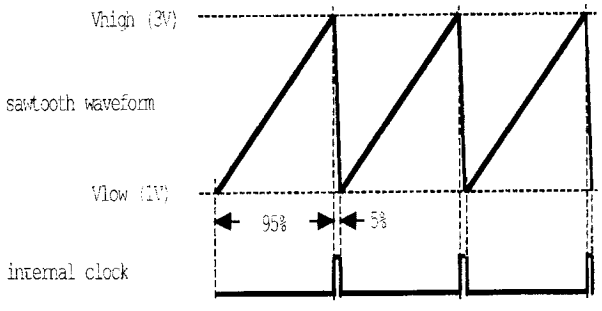
* Oscillator

Oscillator produces fixed control frequency by charging and discharging the timing capacitor Ct with sourcing and sinking current source and offers operating frequency of 20. (2S0800 = 26., 2S0680B. DP104C = 20.). The maximum and minimum voltage of oscillating sawtooth wave is 3V and 1V respectively and it has amplitude of 2V. Oscillator outputs the clock signal during the discharge time of timing capacitor Ct. Gate driver circuit, the final output of control circuit, limits the driving of MOSFET during the clock time by outputting "low". KA2S series limits the maximum duty up to 95%, while KA1L, 1M, 1H series limit the maximum duty up to 70%.

$$fc = . I / (Ct * Vpp)$$



[Oscillator circuit]

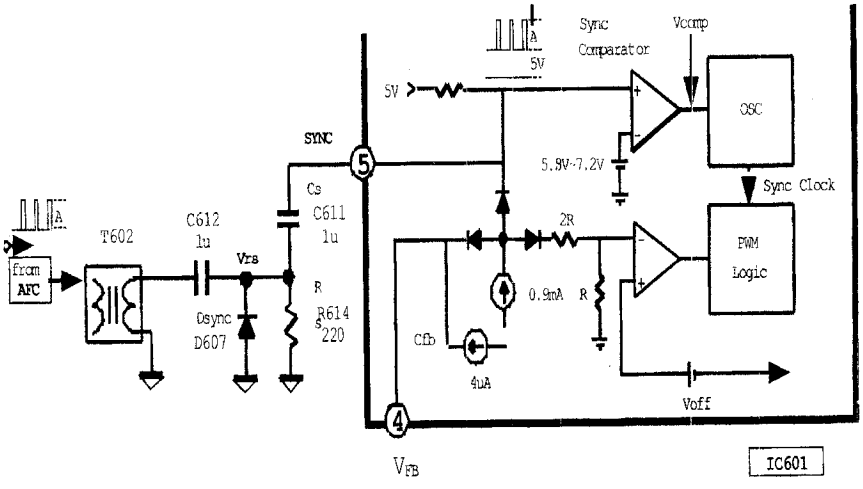


[Sawtooth & clock waveform]

8-4. SYNC circuit

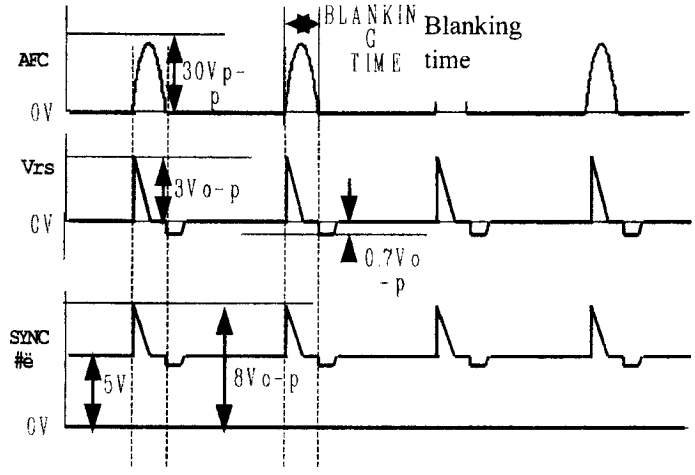
* SYNC

Among SMPS functions for monitors, the function different from general SMPS is SYNC function. The role of sync function is to prevent switching noise from appearing on the screen by synchronizing SMPS switching frequency and SYNC frequency.
It makes the screen noise caused by switching noise place on the far left handed screen of the monitor by synchronizing the switching frequency and "monitor secondary horizontal scanning flyback time". As the result, the screen noise can not be displayed on the screen. Flyback signal is generally used as external sync frequency, which is used when scanning the screen of the monitor horizontally.
The external sync signal does not fall to -0.6V or less because of Rs and Dsync.
Cs potential is maintained at 5V after finishing the early soft start. If external sync signal is on, Vrs is superposed on DC 5V. Sync comparator compares Vcs with 7V and outputs Vcomp. The Vcomp changes the charging operation into discharging operation by setting flip-flop of oscillator. If there is no external sync signal, the OSC oscillates with self-running frequency. The set signal of oscillator that determines "switching on time" synchronizes with the external sync signal. The duration of the set signal is limited to 5% of the whole period. In this control system, the set signal becomes high when synchronizing "horizontal flyback time".

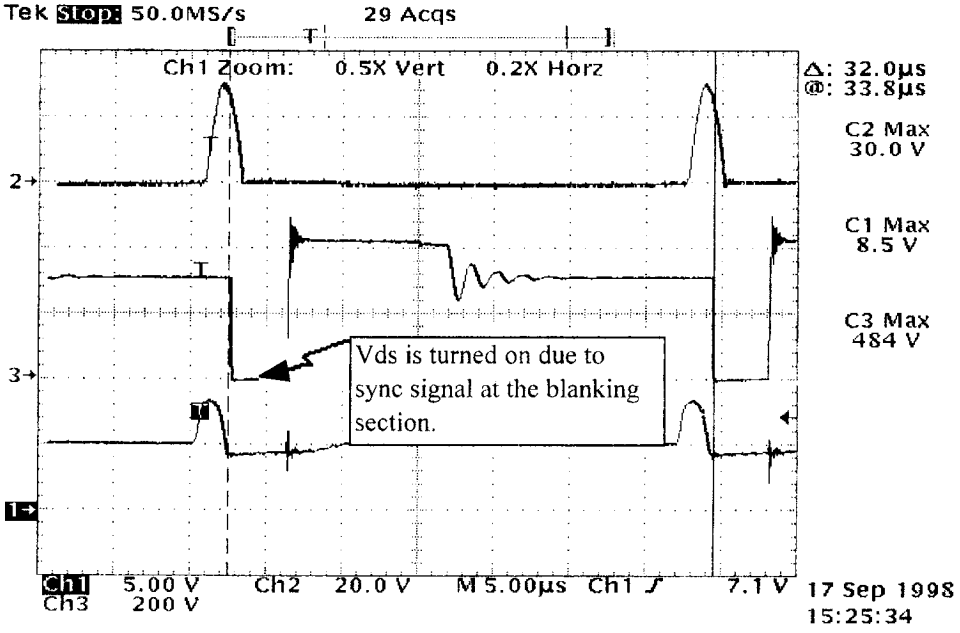


T602 : sync trans
C612, R614 : AFC differential time constant
D607 : negative plus clamping diode
C611 : sync coupling condenser
(including soft/start function)

1) If "horizontal flyback pulse" is applied to T602 from AFC, it flows into the differential circuit and negative clamping circuit and becomes Vrs signal.
2) About 8Vp-p sync voltage is applied to IC601 #5 pin. The 8 volts consists of DC 5V supplied in the inside of the IC and Vrs voltage generated by C611 (coupling condenser) and R614.
3) The moment sync pulse is 7V or higher, sync comparator in the inside of IC operates and applies the high signal to OSC. Therefore, IC 601 begins to operate.



[Sync input circuit operation waveform]



[Sync operation waveform on the actual circuit]

8-5. Feedback circuit and its operating principle

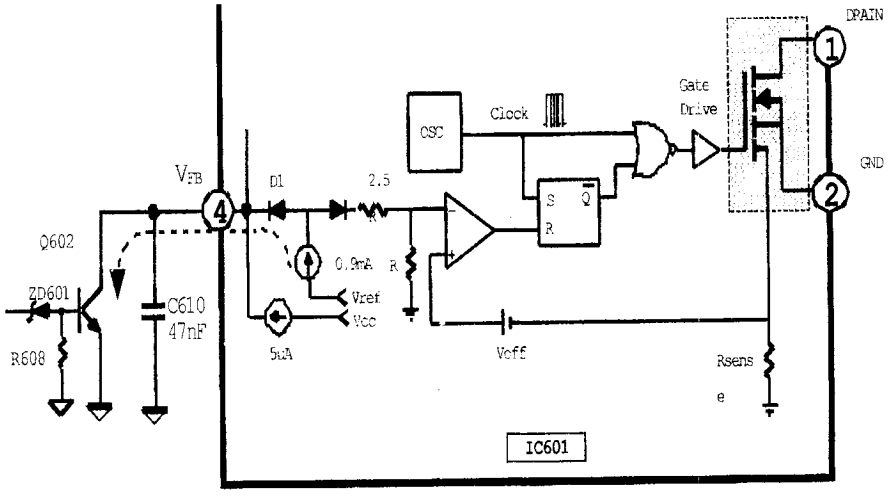
* Feedback

Feedback block is designed to perform two kinds of functions. One is to regulate Vfb voltage and the other is to carry out "delayed shutdown" function. Power trans consists of the primary and secondary. There are primary winding and two kinds of tertiary winding in the primary, while there are secondary windings in the secondary. One of the tertiary winding is to supply Vcc voltage of IC601 and the other is for voltage feedback.

Feedback voltage regulation function is done by modulating the width of "gate driving pulse" after comparing Vfb voltage passed back from "tertiary winding output voltage" with the voltage detected by Rsense of MOSFET. The use of "current sensing resistor" and "low pass filter" in the inside of IC601 reduces that of other external components.

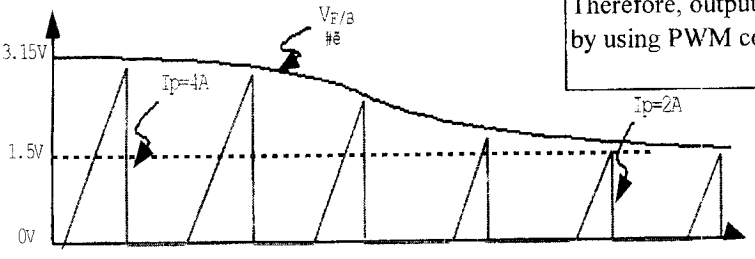
The Vfb voltage for normal operation is at 0 to 3.15V. If the Vfb voltage is 3.15V, the drain current of SENSEFET is at its maximum. At the normal operation section, C610 regulates the output voltage by charging 0.9mA and 4uA and discharging it to Q602.

"Voff" voltage is used to stop the switching operation during no-load situation.

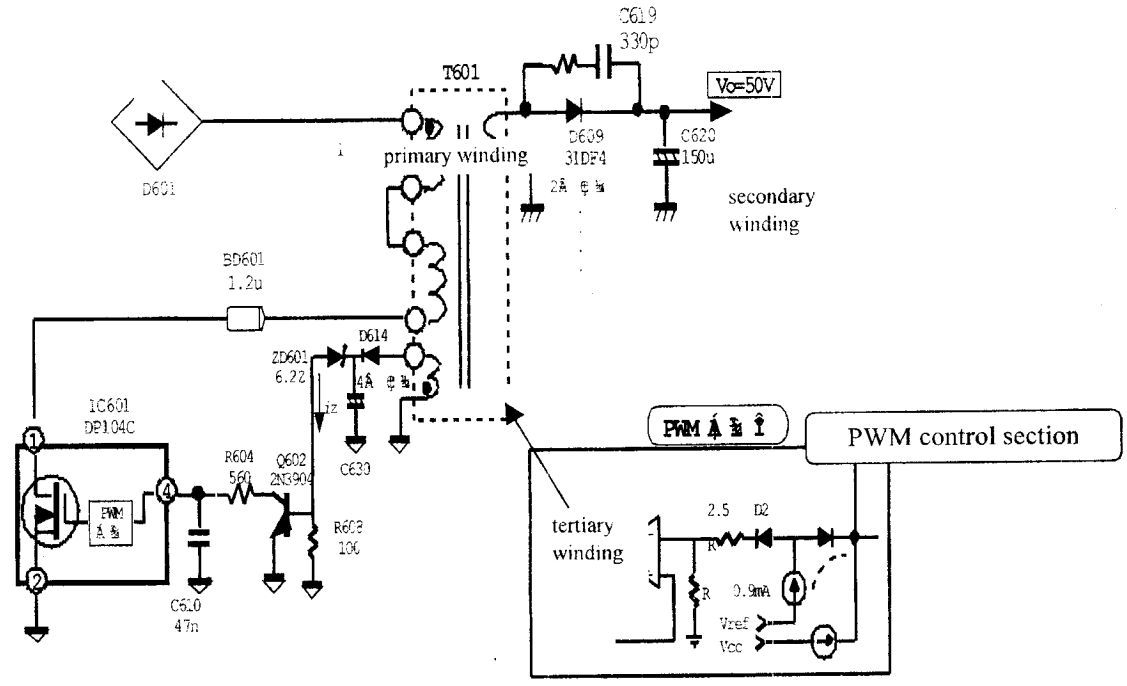


[Feedback internal circuit]

If Vfb voltage is adjusted, Ip value is changed because section ton is modulated.
It means the size of inductance energy saved at Lp is changed according to the following formula, $P=1/2Lp*Ip^2f[w]$.
Therefore, output voltage is also adjusted by using PWM control.



[Feedback voltage and Ip current]



In the above circuit, output voltage Vo operates normally as follows.

1) Q602 senses the voltage changing according to the secondary load and regulates #4 Vfb of IC 601 with the current across D614 and ZD601.

2) If the load in the secondary becomes little and output voltage Vo rises, a lot of energy is transferred to the tertiary winding, so Iz current across D614 and ZD601 increases, too. It means a lot of current flows through the collector of Q602 as more current than usual one is supplied to the base of Q602. Notice that the reference voltage, Vref 0.9mA flows through D1, D2, Ds. If the current across D2 increases, the current across D1 decreases and it means the negative reference voltage of "." comparator is decreased.
After all, Ip current across Lp and output voltage are decreased because "on-duty" is decreased. Therefore, the output voltage is maintained constant.

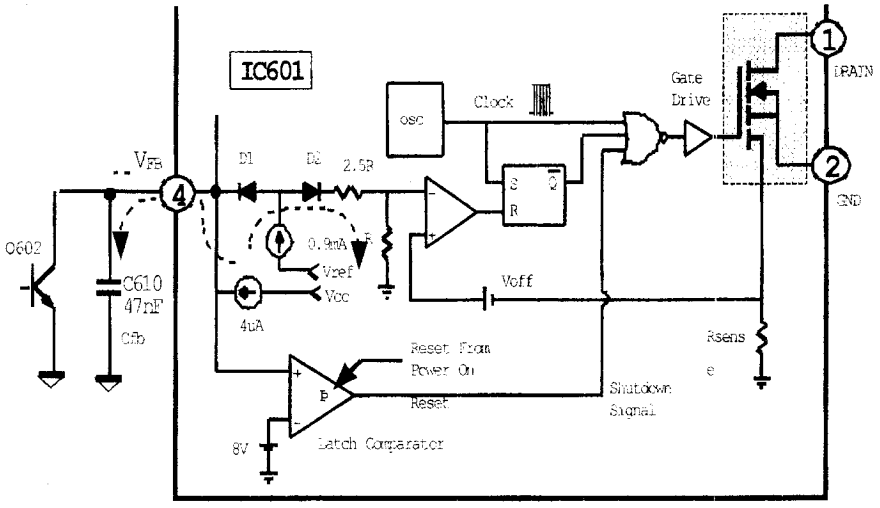
3) On the contrary, if output voltage Vo is decreased, Iz current is decreased, too.
Little current flows through the collector of Q602, so the negative reference voltage of "." comparator is increased. It makes "on-duty" increase and the output voltage is increased. Therefore output voltage is maintained constant.

4) As the operations mentioned above happen repeatedly during very short time, the cathode of ZD601 is maintained at 6.8 to 6.9V regularly.
Vbe (0.6 ~ 0.7V) + D607 zener voltage (6.2V)

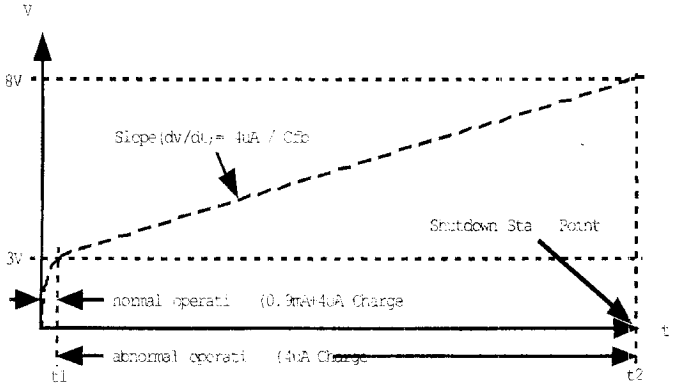
8-6. OCP (Over Current Protection)

* OCP (Over Current Protection)

If horizontal deflection or output circuit of video is short-circuited or there is overload with the horizontal deflection or output circuit of video, SPS-IC senses it and OCP mode (latch-up) operates. When "feedback loop" operates normally, feedback voltage is less than 3.25V more than 0V. If output impedance is in overload status or there is problem with feedback loop, "delayed shut down circuit" operates. The delayed shut down circuit is changed to charging mode when discharge of feedback capacitor is stopped due to Q602. If the feedback voltage is 3.15V or less, C610 is charged with 0.9mA and 4uA. If the feedback voltage is 3.15V or higher, C610 is charged with 4uA because diode D1 is blocked.
If the feedback voltage is 3.15V or lower, the charging slope shows a curved line.
If the feedback voltage is 3.15V or higher, the charging slope shows a straight line.
When the feedback voltage reaches about 8V, the delayed shut down circuit that has latch circuit in it operates and it makes IC shut down. To run the IC again, the power has to be reset. This function is carried out by "power on reset circuit".



[Delayed shut down and feedback circuit]



[Delayed shut down and feedback waveform]

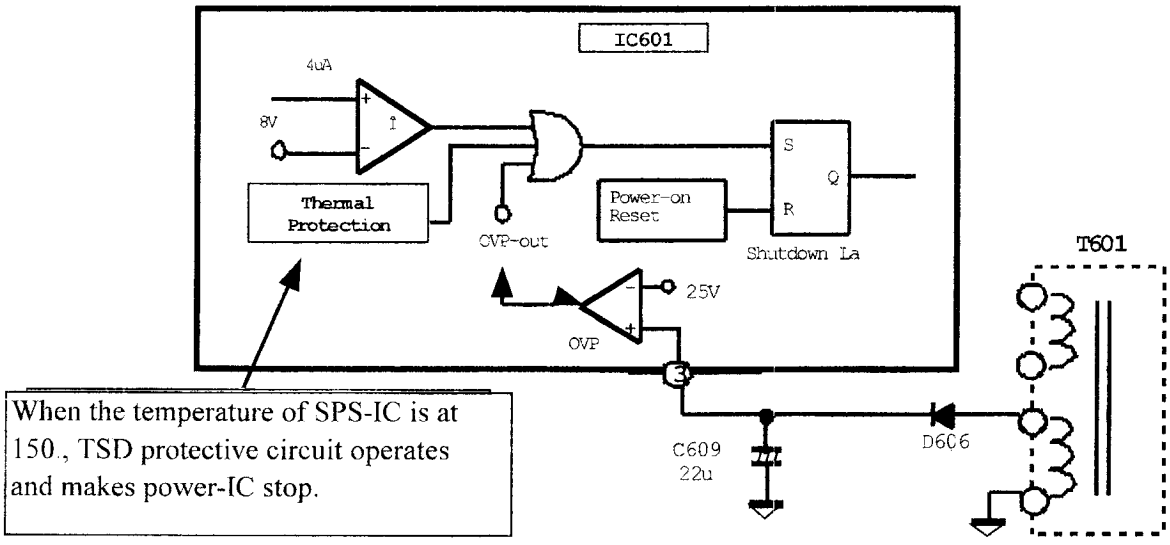
8-7. OVP (Over Voltage Protection)

* OVP (Over Voltage Protection)

OVP is the circuit for protecting parts in the secondary when output voltage is higher than the normal output.

When feedback is not done due to the problem with Vfb, the output voltage rises rapidly. In this case, SPS-IC performs the following operation so as to do OVP function.

1) If the voltage of C609 is normal, its reading is about 18 to 20V. If the secondary output voltage rises due to the Vfb problem, C609 voltage rises rapidly because the sub winding voltage of D606 rises simultaneously.
2) If the voltage of C609 rises to 25V or higher, OVP comparator connected to #3 inside of IC601 detects it and transfers OVP output so as to operate the latch-up protective circuit. Once the latch-up protective circuit operates, SPS-IC operation is stopped.
3) OVP is released only when Vcc (#3) is 6.5V or less according to "power-on reset function".



[Inside of TSD and OVP]

8-8. TSD (Thermal Shut Down)

* TSD (Thermal Shut Down)

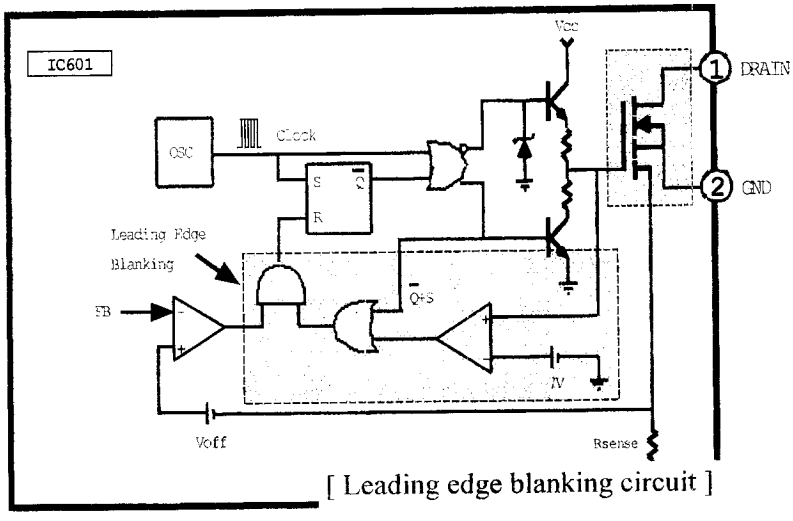
Thermal shutdown is a protective function for preventing IC damage caused by a rise in junction temperature during switching operation. If the temperature of IC chip rises to 150. or higher, the internal thermal shutdown circuit works to stop the operation of whole system. To make it, latch comparator used for delayed shutdown circuit has to be operated.

For re-operation of IC, the power is to be reset. This function is performed by "power on reset circuit".

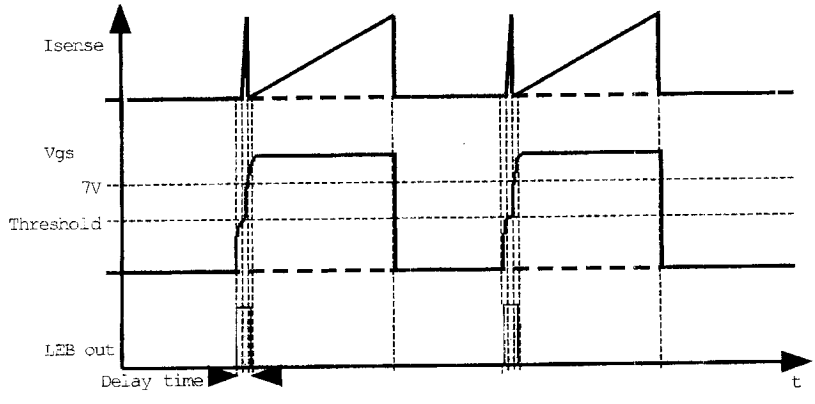
8-9. LEB (Leading Edge Blanking)

* LEB (for 2S series SPS)

Right after the power of MOSFET is on, unwanted pulse current flows. That's because all the following are turned on simultaneously, "reverse recovery current of the secondary rectifier diode" (continuous current mode), discharge current of equivalent capacitor between drain and source, and "gate driving current", as soon as gate pulse of MOSFET reaches "turn-on threshold". Generally, in case of using control IC and MOSFET, the unwanted pulse current is removed by applying RC filter, a low pass filter, to the current sensor block. But the problem is that the current sensed by this RC filter is distorted under normal state. To solve this problem, "gate voltage" has to be sensed right after MOSFET is turned on. The mentioned above is about the function of "leading edge blanking circuit". The leading edge blanking circuit senses the current more correctly than "low pass filter" and it has better temperature characteristics.



[Leading edge blanking circuit]



[Leading edge blanking operating]

9. DPMS

Power saving mode is the function to reduce the waste of electrical power by minimizing power consumption especially when the monitor is not in use. It is possible to reduce power consumption by applying the four types satisfying DPMS (Display Power Management system) regulation.

NO	MODE	SYNC INPUT		Power consumption	LED
		H-SYNC	V-SYNC		
1	NORMAL	ON	ON	approx. 55~80W	GREEN LED ON
2	STAND-BY	OFF	ON	approx. 55W	0.5 sec. Toggle (green/blank)
3	SUSPEND	ON	OFF	10W or less	"
4	POWER-OFF	OFF	OFF	3W or less	1 sec. Toggle (green/blank)

9-1. Operating sequences of DPMS

1) Normal mode
the mode where horizontal and vertical sync are input normally from the video card of PC. All circuits of the monitor operate normally.

2) Stand-by mode
the mode where horizontal sync is not and vertical sync is OK. Micom (IC201) recognizes this state and allows "video-mute". The screen of the monitor maintains "no-video" in order to prevent horizontal screen from collapsing and displaying.

3) Suspend mode
the mode where vertical sync is not and horizontal sync is OK. Micom orders IC401 to stop operation through I^2C communication line once it recognize this mode in Micom (IC201). In this case, vertical/horizontal/high voltage circuit stop operating, while other power supply lines are connected normally. Thus, power consumption of the monitor is reduced to 10W or less.

4) Power-off mode
the mode where vertical/horizontal/high voltage circuit are not input. In this case, all power supplies except Micom power is cut off so that power consumption can not exceed 3W. To meet "Energy 2000" standard, power consumption has to be below 3W, while it used to be below 5W.

1-9-2. Detailed explanation

1) Normal mode

Off port (#6) of Micom IC (IC201) is high in normal mode. The base voltage of Q609, PNP type TR, becomes lower than the emitter voltage because Q610 is turned on. Thus this TR is turned on and 13V-1 is normally provided.
As the off port (#6) is connected to switching port of IC602, the power line of 12V is turned on if the off signal is high. In this case, 6.3V (heater) line works normally as the base voltage of Q604 is high, too.

2) Suspend mode

Micom IC (IC201) orders IC401 (TDA4859) to stop operating through I^2C communication line and horizontal / vertical / high voltage drive signal disappear.
By doing this, the internal power consumption is drastically reduced to 10W or less.

3) Off mode

To reduce power consumption drastically in off mode, it is needed to stop operations of some components in a monitor. Micom and switching circuit help cut off input signal so that input power is cut off or amplifying operation is stopped.
(1) parts whose input power is cut off : IC101, IC102, IC104, IC301, IC401, RL601
T602
(2) parts whose input signal is cut off : OP-AMP of IC603 for driving tilt and H-lin.
* switching parts for cutting off power : IC602, Q609, Q604, Q608

* Precaution : Even though the screen of this model disappears when power switch is turned off, all powers of this model are not turned off. The smoothing condenser in the primary has been charged. The power switch is not connected to AC input, but connected to Vcc line of IC601. It means only switching operation of power section is stopped. Be sure to disconnect signal cable from the PC when repairing a monitor and unplug AC power cord after the power switch is on. In this case, the smoothing condenser in the primary will be suddenly discharged. If AC power cord is unplugged in off mode or suspend mode, the speed of discharge is very slow.