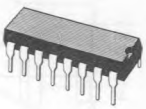
SGS-THOMSON MICROELECTRONICS

TEA2260

SWITCH MODE POWER SUPPLY PRIMARY CIRCUIT

- POSITIVE AND NEGATIVE CURRENT UP TO 1.2A and – 2A
- LOW START-UP CURRENT
- DIRECT DRIVE OF THE POWER TRANSISTOR
- TWO LEVELS TRANSISTOR CURRENT LIMITATION
- DOUBLE PULSE SUPPRESSION
- SOFT-STARTING
- UNDER AND OVERVOLTAGE LOCK-OUT
- LARGE POWER RANGE CAPABILITY IN STAND-BY



TEA2260
BATWING
DIP16
(Plastic Package)

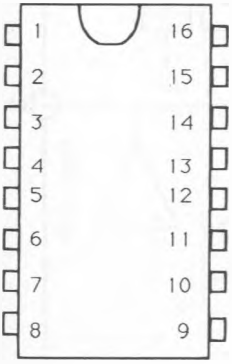
DESCRIPTION

The TEA2260 is a monolithic integrated circuit for the use in primary part of an off-line switching mode power supply.

All functions required for SMPS control under normal operating, transient or abnormal conditions are provided.

The capability of working according to the "master-slave" concept, or according to the "primary regulation" mode makes the TEA2260 very flexible and easy to use. This is particularly true for TV receivers where the IC provides an attractive and low cost solution.

PIN CONNECTIONS



1	IS	Transformer demagnetization sensing input
2	IN	Secondary pulses input
3	IMAX	Power transistor current limitation input
4	GND	Ground
5	GND	Ground
6	E	Error amplifier input (invertin)
7	S	Error amplifier output
8	C2	Overload integration capacitor
9	C1	Soft-start capacitor
10	CO	Oscillator capacitor
11	RO	Oscillator resistor
12	GND	Ground
13	GND	Ground
14	OUT	Power output
15	V+	Positive output stage supply
16	VCC	Power supply

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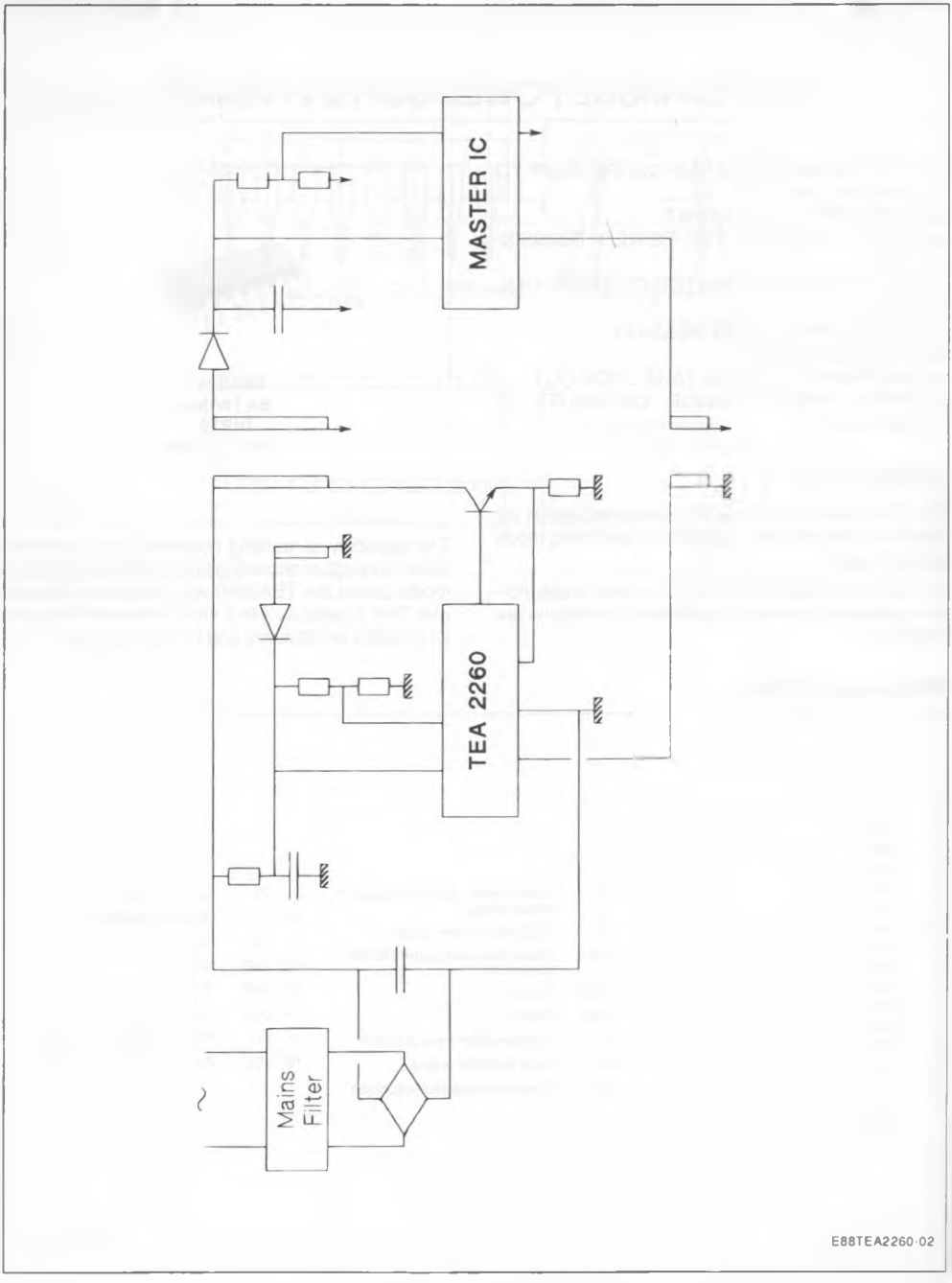
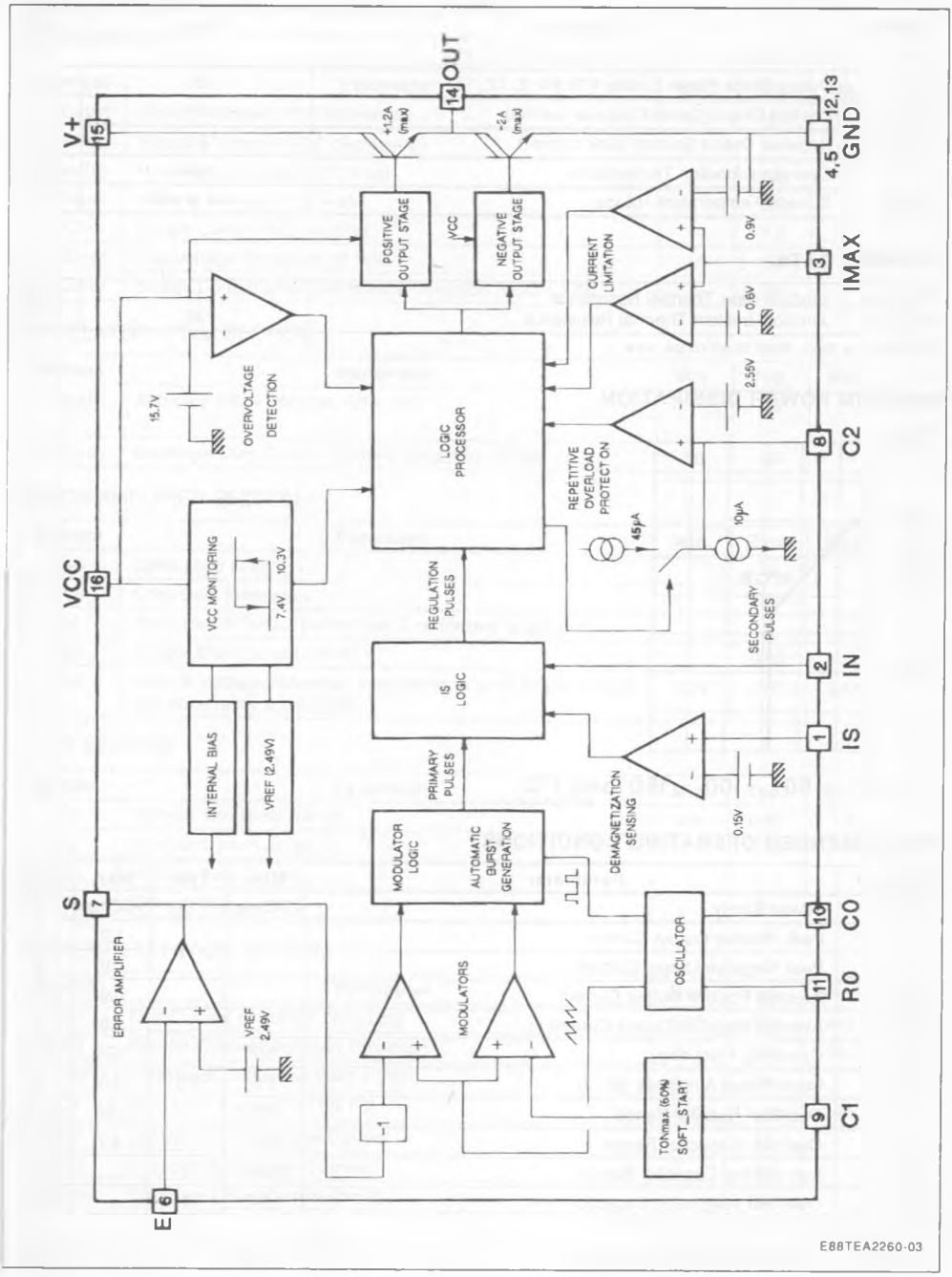
Figure 1 : Simplified Application Diagram.



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

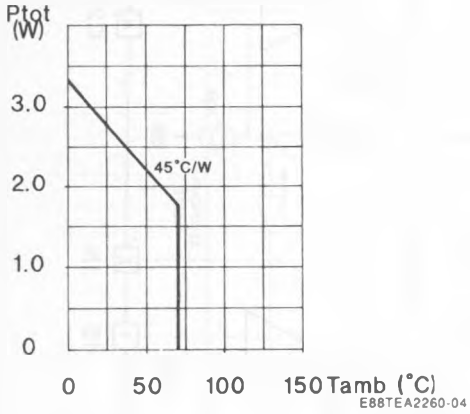
Symbol	Parameter	Value	Unit
VCC	Power Supply V16-V4, 5, 12, 13	20	V
V+	Output Stage Power Supply V15-V4, 5, 12, 13	20	V
IOUT+	Positive Output Current (source current)	1.5	A
IOUT–	Negative Output Current (sink current)	2.5	A
Tj	Operating Junction Temperature	150	°C
Tstg	Storage Temperature Range	– 40 to 150	°C

THERMAL DATA

Rth (j-c)	Junction-case Thermal Resistance	11	°C/W
Rth (j-a)*	Junction-ambient Thermal Resistance	45	°C/W

* Soldered on a 35µm, 40cm^2 board copper area.

MAXIMUM POWER DISSIPATION



RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min.	Typ.	Max.	Unit
VCC	Power Supply	VCCstop	12	VCCmax	V
Iout+	Peak Positive Output Current			1.2	A
Iout–	Peak Negative Output Current			2.0	A
Iout+	Average Positive Output Current			0.6	A
Iout–	Average Negative Output Current			0.6	A
Fop	Operating Frequency	10		100	KHz
Vin	Input Pulses Amplitude (pin 2)	1.5	2.5	4.5	V
R0	Oscillator Resistor Range	20		150	KΩ
C0	Oscillator Capacitor Range	0.47		4.7	nF
C1	Soft-starting Capacitor Range	0.047	1		µF
C2	Overload Integration Capacitor	0.047	1		µF
C2/C1	Ratio C2/C1 (C2 must be ≥ C1)	1			
Tamb	Operating Ambient Temperature	– 2.0		70	°C

ELECTRICAL CHARACTERISTICS :
Tamb = 25°C, VCC = 12V (unless otherwise specified)

POWER SUPPLY

Symbol	Parameter	Min.	Typ.	Max.	Unit
VCCstart	Starting Voltage (VCC increasing)	9.3	10.3	11.3	V
VCCstop	Stopping Voltage (VCC decreasing)	6.4	7.4	8.4	V
HystVCC	Hysteresis (VCCstart-VCCstop)	2.4	2.9		V
ICCstart	Starting Current (VCC = 9V)		0.7	1.4	mA
ICC	Supply Current (VCC = 12V)		7.5	15	mA
VCCmax	Overvoltage Threshold on VCC	15	15.7		V
ICCover	Supply Current after Overvoltage Detection (VCC = 17V)		35		mA

OSCILLATOR / PWM SECTION

Symbol	Parameter	Min.	Typ.	Max.	Unit
$\frac{DeltaF}{F}$	Accuracy (R0 = 68Kohm, C0 = 1nF)		10		%
TONmax	Maximum Duty Cycle in Primary Regulation Mode	50	60	70	%

ERROR AMPLIFIER SECTION

Symbol	Parameter	Min.	Typ.	Max.	Unit
Avo	Open Loop Gain		75		dB
Fug	Unity Gain Frequency		550		KHz
Isc	Short Circuit Output Current(pin 7 connected to ground)		2		mA
IBE	E Input Bias Current (pin 6)		0.08		µA
Vref	Internal Voltage Reference (connected to error amplifier input and not directly accessible)	2.34	2.49	2.64	V

INPUT SECTION

Symbol	Parameter	Min.	Typ.	Max.	Unit
Vin	IN Input Threshold (pin 2)	0.6	0.85	1.2	V
Vis	IS Input Threshold (pin 1)		0.15		V
IBin	IN Input Bias Current		0.3		µA
IBis	IS Input Bias Current		0.4		µA

CURRENT LIMITATION SECTION

Symbol	Parameter	Min.	Typ.	Max.	Unit
VIM1	First Current Limitation Threshold	558	600	642	mV
VIM2	Second Current Limitation Threshold	837	900	963	mV
Δ VIM	Thresholds Difference VIM2 - VIM1		300		mV
VC2	Lock-out Threshold on Pin C2	2.25	2.55	2.85	V
IDC2	Capacitor C2 Discharge Current		10		µA
ICC2	Capacitor C2 Charge Current		45		µA
IBImax	IMAX Input Bias Current (pin 3)		0.2		µA

GENERAL DESCRIPTION

The new SMPS integrated circuit is suitable for the use in TV set working on the mains from 90 to 270Vac. The circuit can also be used in others consumer applications such as VCR, monitors...

The circuit ensures itself the starting of SMPS and the "stand-by" mode operating using the primary regulation principle.

The circuit ensures the "normal operating" mode in association with a secondary regulator, discrete or integrated device.

The power transmitted in standby can vary in a large range (e.g. 1 to 30W or more) with an acceptable voltage regulation.

The transition : normal mode - stand-by mode is made automatically by secondary regulation pulses occurence or disappearance.

The circuit can also be used alone, according to the primary regulation concept.

The circuit ensures the direct drive of a bipolar power transistor (without external boosters).

The circuit ensures security functions such as power transistor current limitation, power limitation in case of SMPS output overload or short circuit, overvoltage detection in case of primary or secondary regulator failure.

SMPS OPERATING DESCRIPTION

STARTING MODE - STAND BY MODE

Power for circuit supply is taken from the mains through a high value resistor before starting. As long as VCC of the TEA2260 is below VCCstart, the quiescent current is very low (typically 0.7mA) and the electrolytic capacitor across VCC is linearly charged. When VCC reaches VCCstart (typically 10.3V), the circuit starts, generating output pulses with a soft-starting. Then the SMPS goes into the stand-by mode and the output voltage is a percentage of the nominal output voltage (eg. 80%).

For this the TEA2260 contains all the functions required for primary mode regulation : a fixed frequency oscillator, a voltage reference, an error amplifier and a pulse width modulator (PWM).

For transmission of low power with a good efficiency in stand-by, an automatic burst generation system is used, in order to avoid audible noise.

NORMAL MODE (secondary regulation)

The normal operating of the TV set is obtained by sending to the TEA2260 regulation pulses generated by a regulator located in the secondary side of the power supply.

This architecture uses the "Master-slave Concept", advantages of which are now well-known especially the very high efficiency in stand-by mode, and the accurate regulation in normal mode.

Stand-by mode or normal mode are obtained by supplying or not the secondary regulator. This can be ordonnered for exemple by a microprocessor in relation with the remote control unit.

Regulation pulses are applied to the TEA2260 through a small pulse-transformer to the IN input (pin 2). This input is sensitive to positive square pulses. The typical threshold of this input is 0.85V.

The frequency of pulses coming from the secondary regulator can be lower or higher than the frequency of the starting oscillator.

The TEA2260 has no soft-starting system when it receives pulses from the secondary. The soft-starting has to be located in the secondary regulator.

Due to the principle of the primary regulation, pulses generated by the starting system automatically disappear when the voltage delivered by the SMPS increases.

STAND-BY MODE - NORMAL MODE TRANSITION

During the transition there are simultaneously pulses coming from the primary and secondary regulators.

These signals are not synchronized and some care has to be taken to ensure the safety of the switching power transistor.

A very sure and simple way consist in checking the transformer demagnetization state.

- A primary pulse is taken in account only if the transformer is demagnetized after a conduction of the power transistor required by the secondary regulator.
- A secondary pulse is taken in account only if the transformer is demagnetized after a conduction of the power transistor required by the primary regulator.

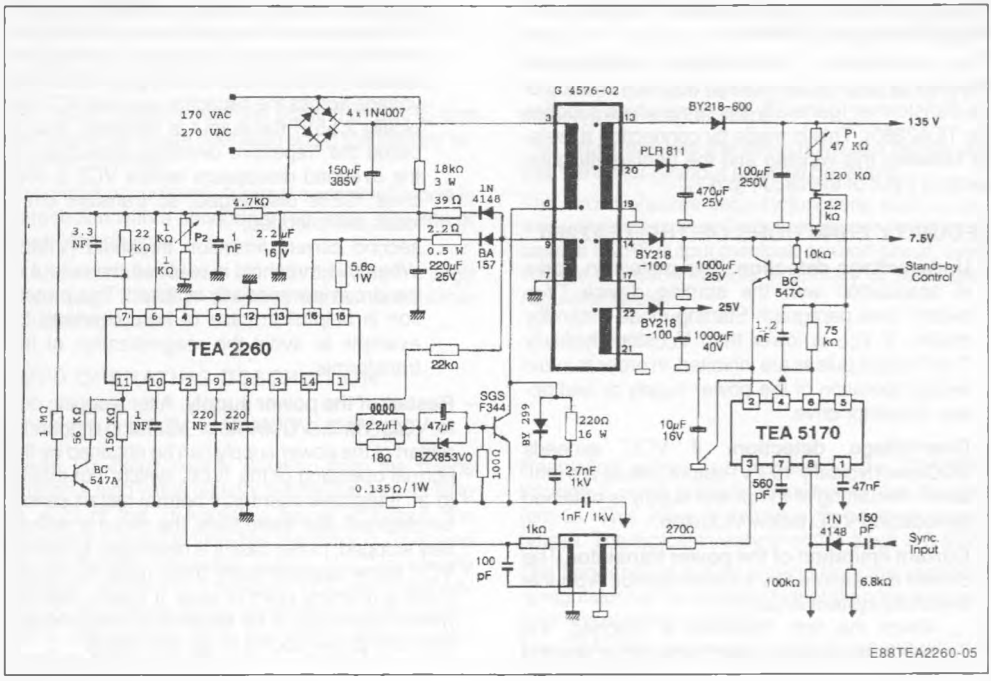
With this arrangement the switching safety area of the power transistor is respected and there is no risk of transformer magnetization.

The magnetization state of the transformer is checked by sensing the voltage across a winding of the transformer (generally the same which supplies the TEA2260). This is made by connecting a resistor between this winding and the demagnetization sensing input of the circuit (pin 1).

SECURITY FUNCTIONS OF THE TEA2260

- **Undervoltage detection.** This protection works in association with the starting device "V_{CC} switch" (see paragraph Starting-mode - standby mode). If V_{CC} is lower than V_{CC}stop (typically 7.4V) output pulses are inhibited, in order to avoid wrong operation of the power supply or bad power transistor drive.
- **Overvoltage detection.** If VCC exceeds VCCmax (typically 15.7V) output pulses are inhibited. Restarting of the power supply is obtained by reducing VCC below VCCstop.
- **Current limitation of the power transistor.** The current is measured by a shunt resistor. A double threshold system is used :
  - When the first threshold is reached, the conduction of the power transistor is stopped until the end of the period : a new conduction signal is needed to obtain conduction again.
  - Furthermore as long as the first threshold is reached (it means during several periods), an external capacitor C2 is charged. When the voltage across the capacitor reached VC2 (typically 2.55V) the output is inhibited. This is called the "repetitive overload protection". If the overload disappears before VC2 is reached, C2 is discharged, so transient overloads are tolerated.
  - second current limitation threshold (VIM2). When this threshold is reached the output of the circuit is immediatly inhibited. This protection is helpfull in case of hard overload for example to avoid the magnetization of the transformer.
- **Restart of the power supply**. After stopping due to VC2, VIM2, VCCMAX or VCCstop triggering, restart of the power supply can be obtained by the normal operating of the "VCC switch" but thanks to an integrated counter, if normal restart cannot be obtained after three trials, the circuit is definitively stopped. In this case it is necessary to reduce VCC below approximately 5V to reset the circuit. From a practical point of view, it means that the power supply has to be temporarily disconnected from any power source to get the restart.

TYPICAL APPLICATION



TV - SET SMPS (with TEA5170)

Input voltage range	170VAC – 270VAC
Input DC voltage range	210VDC – 370VDC
Output power in normal mode	25W < Po < 140W
Output power in stand by mode	2W < Po < 45W
Operating frequency	32 KHz
Efficiency at full load	> 80%
Efficiency in stand by mode (Po = 7W)	> 50%
Short circuit protected	
Open load protected	
Long duration overload protected	
Complete shutdown after 3 restarts with default detection	

load regulation (VDC = 310V)

Output 135V (± 0.18%) ——> (I_{135} : 0.01A to 0.8A ; I_{25} = 1A)

Output 25V (± 2%) ——> (I_{135} : 0.8A ; I_{25} : 0.5A —> 1A)

Line regulation

Output 135V (± 0.13%) ——> (210V < V_{DC} < 370V)

Output 25V (± 0.17%) ——> (I_{135} : 0.8A ; I_{25} : 1A)

PACKAGE MECHANICAL DATA

16 PINS - PLASTIC DIP