Design Idea DI-26

TOPSwitch®-GX 7 W Digital Video Broadcast-Terrestrial (DVB-T) Supply

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
DVB-T	TOP242P	7 W	195 to 265 VAC	2.5 V / 3.3 V / 6.2 V / 30 V	Flyback

Design Highlights

- Meets CISPR22B/EN55022B conducted EMI limits with output return grounded
- <0.5 W input power at zero load
- 132 kHz operation and programmable current limit allows small, low cost EF16 transformer for 7 W output
- Low component count design occupies 80 x 30 x 16 mm
- Integrated soft-start reduces start-up component stresses

Operation

The *TOPSwitch-GX* flyback supply provides 4 outputs, delivering 7 W from a 230 VAC ±15% input. The TOP242P was selected for low cost, the DIP-8 package removing the need for an external heat sink. Resistor R7 programs the internal TOP242P current limit to 78% of nominal, just above the level needed for full load at low line. This feature allows a more continuous transformer design for better efficiency and cross-regulation, without requiring a larger core size.

Resistor R12, C10 and L2 filter conducted EMI; R12 is a flame-proof fusible type, also functioning as a fuse. For lower cost, if the supply does not have to meet conducted EMI with the output connected to earth ground, the common mode choke can be replaced with a π filter. A Zener clamp (D11 and VR1) was selected over an RCD clamp to minimize zero load consumption. Secondary side feedback is taken from the 3.3 V ±5% output since this has the tightest tolerance requirement. The 2.5 V ±5% output is derived directly from the 3.3 V output using D4. A 60 V Schottky was selected for D1, since the slightly higher forward drop centers the 6.2 V and 30 V outputs.

Post-filters (L1/C3, L2/C12 and R1/C5) reduce output noise and ripple to <±1% of the respective output voltage. A soft-finish capacitor (C7) eliminates output turn-on overshoot.

Key Design Points

- The transformer is designed to operate in continuous mode for tight secondary cross-regulation.

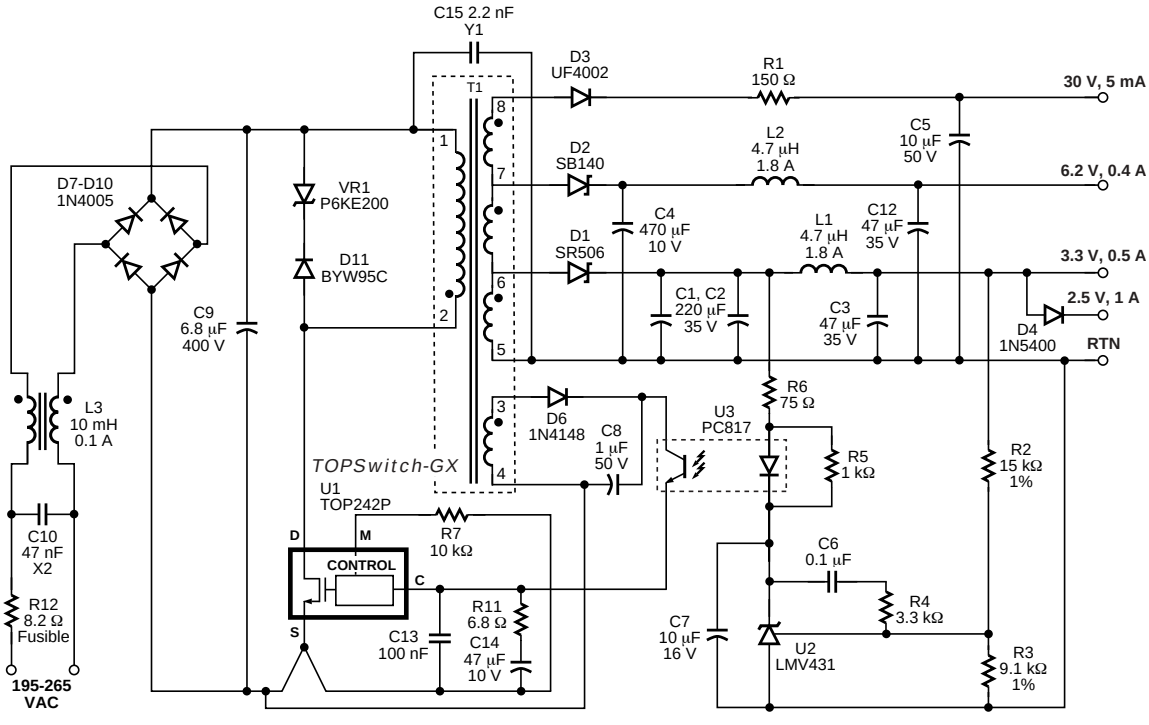

Figure 1. TOPSwitch-GX 7 W Multiple Output Supply for DVB-T.

- Safety Y1 capacitor C15 is connected between secondary return and primary DC rail to minimize noise coupling during AC common mode line transients.
- Good layout practices should be followed:
  - Locate C13, R11 and C14 close to U1, with grounds returned to the SOURCE pin.
  - Minimize the primary and secondary loop areas to reduce parasitic leakage inductance, improve EMI and cross-regulation.

TRANSFORMER PARAMETERS	
Core Material	EF16 gapped for 190 nH/T^2
Bobbin	EF16-8 pin
Winding Details	Primary: 105T, 35 AWG Bias: 17T, 35 AWG 3.3 V Secondary: 4T, 4 x 26 AWG T.I.W. 6.2 V Secondary: 3T, 26 AWG T.I.W. 30 V Secondary: 29T, 30 AWG T.I.W. (T.I.W. = Triple Insulated Wire)
Winding Order (Pin Numbers)	Primary (1-2), Tape, Bias (3-4), Tape, 3.3 V (5-6), 5 V (6-7), 30 V (7-8)
Inductance	Primary: 2.1 mH ± 10%, Leakge: 50 μH (max.)
Primary Resonant Frequency	650 kHz (minimum)

Table 1. Transformer Construction Information.

Voltage (V)	Load Range (%)	Regulation (%)											
		-10	-7	-4	-3	-2	-1	0	1	2	3	4	7
2.5	10-100												
3.3	10-100												
6.2	10-100												
30	100												

Table 2. Worst Case Output Cross-Regulation-all Outputs Taken from Minimum to Maximum Load.

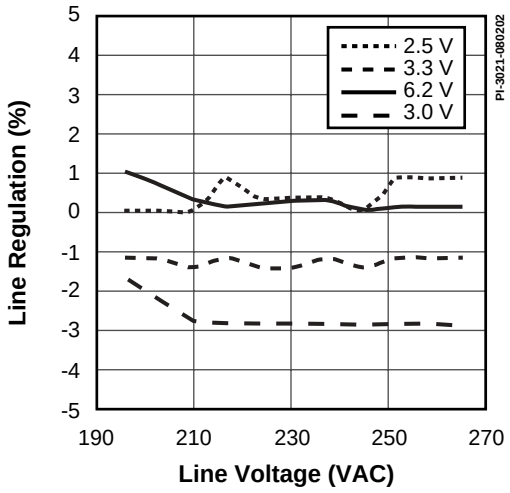

Figure 2. Full Power Line Regulation.

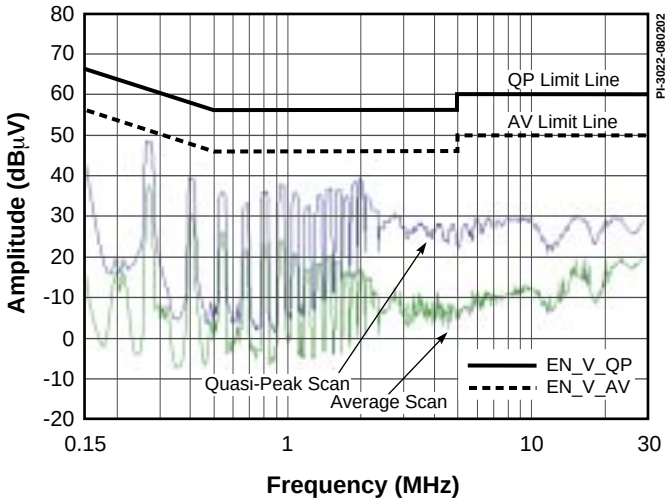

Figure 3. Conducted EMI, 230 VAC, Full Power, Output Earth Grounded.

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