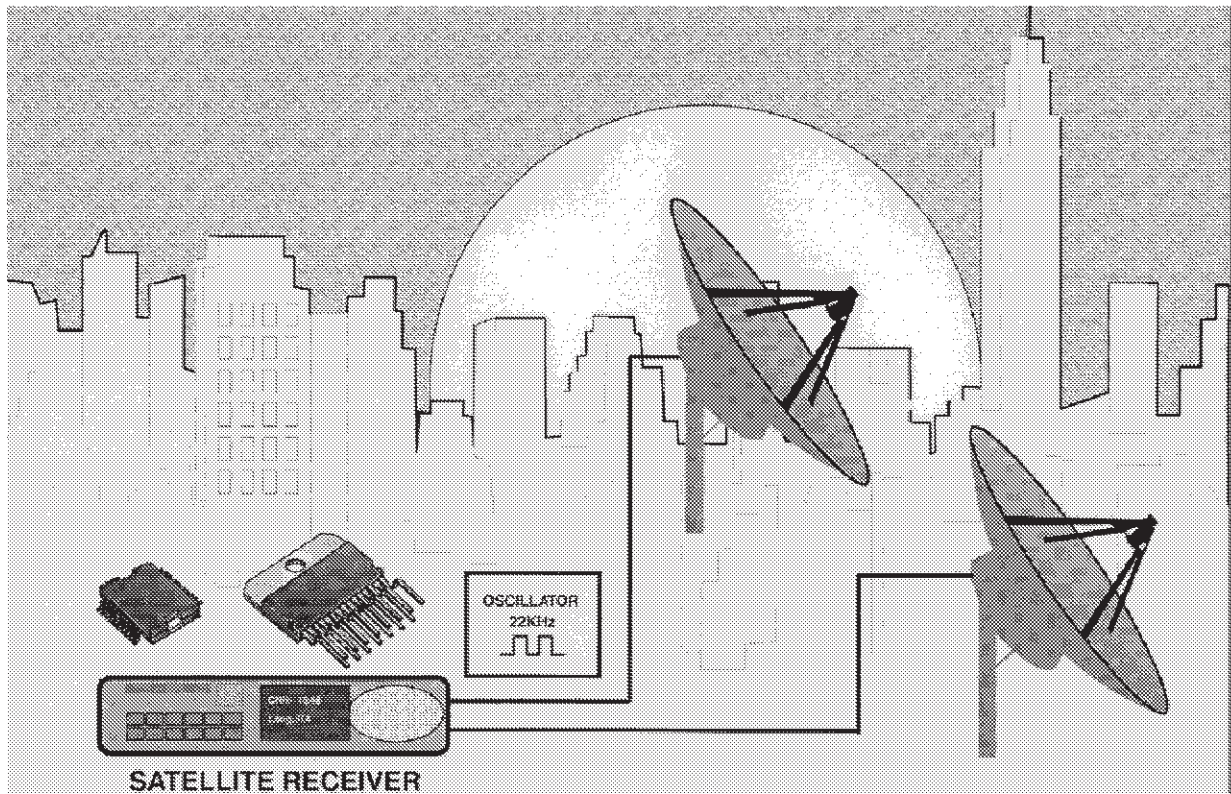


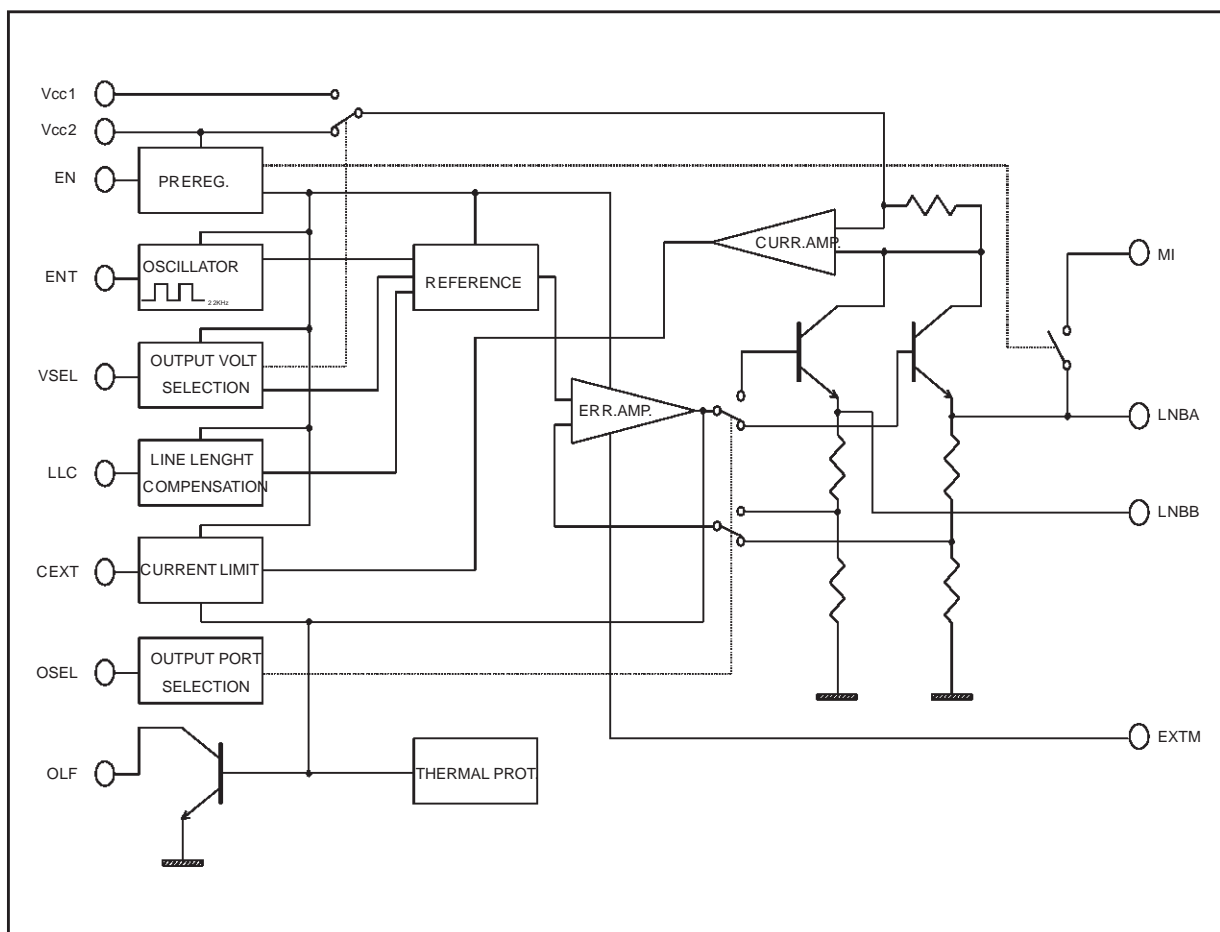
THE LNBP10 AND LNBP20 APPLICATION HINTS



DESCRIPTION LNB SUPPLY AND CONTROL VOLTAGE REGULATOR VERSUS DISCRETE SOLUTION IN SATELLITE TV RECEIVERS

In this note it is described the application environment in which the LNBPxx device operates and which are the benefits it brings against the discrete solutions most frequently adopted in satellite TV set-top-boxes. From the application point of view, the very minimum requirement for this application is to get a selectable 13/18 V regulated DC output, 500mA, on which a 22KHz square wave can be superimposed or not. Even if the task seems simple, a discrete approach always leads to a complex circuit, full of trade-offs to keep low the cost, especially when some extra features are needed.

Figure 1.



PROBLEM:

An adjustable Vreg has to provide one out of 2 selectable (fixed) voltages or to be shut-down.

DISCRETE SOLUTION:

Usually a combination of adjustable resistors (or precision resistors) in the feedback voltage divider are selected by small switch transistors.

DRAWBACKS:

Output accuracy is poor, especially with temperature; add the cost of precision resistors or adjustable ones plus the alignment cost.

LNBPxx SOLUTION:

A logic level pin simply selects the internally fixed 13 or 18 V on output, both at max +/-5% tolerance over full temperature range. No adjustments are needed. Another logic level pin puts the IC in standby.

PROBLEM:

The 22 (+/-2) KHz logic controlled tone has to fulfil "ASTRA" spec for amplitude, frequency, duty-cycle, rise and fall edges, and must have 0V average value.

DISCRETE SOLUTION:

Cannot be described by words! Try to imagine the many solutions.

DRAWBACKS:

High costs to get good results. Less expensive hardware asks for tricky factory adjustments and/or incomplete spec. compliance.

LNBPxx SOLUTION:

A logic pin simply activates a built-in oscillator. The IC itself guarantees the "ASTRA" spec in all parameters, because the oscillator circuit is internally factory trimmed.

A special architecture achieves a 0V shift of the average DC output when the tone is inserted.

PROBLEM:

If the satellite receiver is unplugged from the main supply, other receivers can use the same antenna cables to supply the LNBS. So a voltage as high as 18V could be present on the output of an unpowered regulator who has to survive while draining no current.

DISCRETE SOLUTION:

A Schottky rectifier is placed in series with the regulator output.

DRAWBACKS:

Poor regulation, especially in temperature; asymmetry in the edges of the 22KHz tone due to asymmetrical Source/sink resistance.

LNBPxx SOLUTION:

No external diodes or other components are needed. Each regulator output of the IC is guaranteed to sink less than 2mA when externally forced at 20V.

PROBLEM:

Many analog satellite receivers have 2 LNB ports. Only one at a time must be active.

DISCRETE SOLUTION:

The regulator's output has two PNP transistors used as switches. Each one powers an LNB.

DRAWBACKS:

Voltage regulation is poor; each PNP switch needs an NPN for base drive; PNP are not protected against output short circuit, so they must be dimensioned according to max out current of the regulator. Better results by doubling the NPN regulation pass transistor. Each emitter drives an output but only one base is driven by the error amplifier. Higher costs and the selection circuit is complicated because also the feedback path has to be switched from one output to the other one.

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LNBPxx SOLUTION:

The IC has two logic selectable outputs, each one fully complying with the specs and fully protected.

PROBLEM:

Satellite receiver installations sometimes have a long cable connecting the antenna to the receiver. This results in a considerable DC voltage drop that could lead to LNB malfunction.

DISCRETE SOLUTION:

A forward biased silicon diode in the feedback path or in the reference adds a V_f (0.6V) to the V_{out} value in order to roughly compensate that drop. When the compensation is not needed, a small switch transistor driven by a switch or by the +C shunts the diode.

DRAWBACKS:

Accuracy degradation of V_{out} with and without drop compensation; temperature dependence; component count continuously growing.

LNBPxx SOLUTION:

A logic controlled pin increases the V_{out} by 1V, still keeping a +/-5% accuracy of V_{out} over full temperature range.

PROBLEM:

The supply voltage of the regulator, considering the max V_{out} (18V) and the pass element drop (2V if NPN Darlington), requires at least 20 V supply as V_{in} . The problem is that when the V_{out} is selected to be 13V, the pass element will dissipate at least $3.5W = (20-13)V \cdot 0.5A$.

DISCRETE SOLUTION:

The heatsink of the pass element is dimensioned according to the max dissipation. High-end receivers implement a dual-supply for the LNB regulator, that is a solid state SPDT who selects the right V_{in} (20 or 15V) to let the regulator work at minimum drop.

DRAWBACKS:

Wasting of space and power in low cost solution (big issue for SMT).
Optimised solution has high impact on the cost.

LNBPxx SOLUTION:

The IC has two supply input pins and a built-in SPDT solid state switch. Each supply pin should be connected to the appropriate supply voltage and, according to the selected V_{out} (13 or 18V), the built-in switch selects one out of the two voltages. If heatsinking is not a problem and dual supply is impractical, the two supply pins can be connected together to a common supply voltage not lower than 22V.

PROBLEM:

If a short circuit occurs somewhere in the antenna and cable installation, even if the regulator has a current limitation at 600mA, the pass element will dissipate a lot of power (10W and more).

DISCRETE SOLUTION:

Heatsink oversizing, or foldback current limitation.

DRAWBACKS:

Waste of space because the heatsink is dimensioned for short circuit condition (impractical for SMT). Foldback limit could cause severe problems at power-on or when normal conditions are restored. In other words, the system could latch each time the capacitor charge-up causes a current peak.

LNBPxx SOLUTION:

The IC has a dynamic current limit protection that works by "check and retry" until the short circuit condition has overcome. The actual ON/OFF duty-cycle is about 1/15. By this way, the power dissipated in short circuit is even less than when operating, still assuring a graceful recovery from any overload and a reliable power-on.

PROBLEM:

Satellite receive systems are often composed by 2 or 3 receivers all sharing the same antenna system. Only one receiver is active and powering the LNB, while the others are in standby. The system must be enough flexible to let any receiver be the master still avoiding power and control collisions. The best architecture is a chain in which each receiver has a coax connector from the previous receiver and another coax connector to the next one or, if it is the last one, straight to the LNB. Each receiver can be either in standby or active: if it is in standby it bypasses the two connectors, letting the DC pass-thru; if it is active, the DC path between the connectors is interrupted, and it delivers DC and controls to next receiver and then, step by step along the chain (if all following receivers are in stand-by), to the LNB.

DISCRETE SOLUTION:

Usually a switch transistor or a small relay provides this bypass function.

DRAWBACKS:

Part count and cost continues to increase.

LNBPxx SOLUTION:

The bypass switch is built-in and automatically closed when the IC is set in standby mode. No external components are needed.

CONCLUSIONS:

LNBPxx IC offers a no trade-off, single chip solution to all problems related to the most commonly used discrete architectures adopted in set-top-boxes for powering and remote controlling the LNB module. Designed to comply to ASTRA specification, its flexibility allows easy implementation of custom protocols or forthcoming specifications. Besides, in low cost applications in which all functions are not needed, a simplified version in PowerSO-10 offers a choice of options that still can match design needs while saving money and board space.

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