

## PRODUCT SUMMARY

# SKY68001-41: LTE Universal Multi-Band Front-End Module for IoT

## Applications

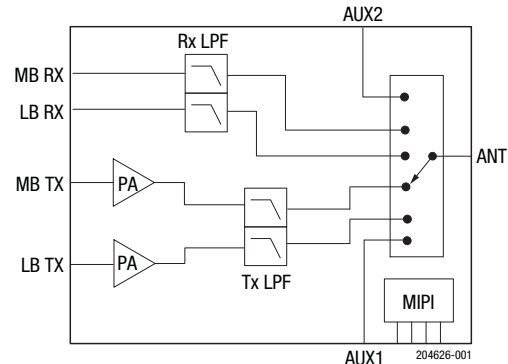
- Cellular IoT modem devices targeting low-power wide area network (LPWAN):
  - 4G LTE technology capability
  - Dedicated LTE half-duplex operation (HD-FDD) for LTE-M/NB-IoT
  - Designed to meet 3GPP Rel-12 and Rel-13 specifications (with compatible cellular transceiver)
- LTE universal modem products (low-band and mid-band):
  - Low-band B5, B8, B12, B13, B17, B18, B19, B20, B26, B28
  - Mid-band B1, B2, B3, B4, B25, B39, and B66
- PAE optimized for Class 3 LTE output power (+23 dBm)

## Features

- Cost-optimized front end for low-data-rate applications
- Low-loss post-PA transmit front end for enhanced transmitter efficiency (compared to LTE-FDD radio front ends)
- Broadband PA supporting APT mode of operation or Vcc fixed supply ( $\geq 2.85$  V)
- Integrated low-pass filters for harmonic rejection to comply with spurious emission requirements
- Integrated SP6T antenna Tx/Rx switch
- Integrated Rx low-pass filters for out-of-band rejection
- Optimized to support LTE for 1 to 6 RB
- MIPI® RFFE control interface, 2.0 compliant
- Pin-to-pin compatible with the SKY68000-31 and SKY68011-31
- Two additional Aux ports offer greater flexibility for more bands on the Tx or Rx path
- Adaptive biasing scheme for maximum PA efficiencies
- Small, low-profile package (4 mm x 5 mm x 0.9 mm) (MSL3 @ 260 °C per JEDEC J-STD-020)
- Lead (Pb)-free and RoHS-compliant



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**Figure 1. SKY68001-41 Functional Block Diagram**

## Description

The SKY68001-41 is a hybrid, multi-band multi-chip RF front-end (RFFE) module supporting cellular LTE M/NB-IoT (half-duplex system) transceiver platforms. The module integrates the entire RF front end necessary for an LTE multi-band radio operating in low-band (B5, B8, B12, B13, B17, B18, B19, B20, B26, and B28) and mid-band (B1, B2, B3, B4, B25, B39, and B66) frequencies, including Rx low-pass filters, broadband PA with bias controller, Tx low-pass harmonic filter, antenna switch, and MIPI RFFE controller.

## Tx Section

The PA load-line is optimized for high efficiency while simultaneously meeting 3GPP ACLR and emissions mask specifications with LTE up to 6 RB. An integrated LPF is implemented to reject the PA and transceiver harmonics while at the same time minimizing any post PA loss for an optimized transmit current consumption. Out-of-band emissions performance is emphasized by the design to be 3GPP-compliant for low-band (B5, B8, B12, B13, B17, B18, B19, B20, B26, and B28) and mid-band (B1, B2, B3, B4, B25, B39, and B66).

## Rx Section

Receive low-pass filters are integrated into the module along with the necessary matching to yield a 50  $\Omega$  single-ended impedance for the antenna and Rx ports. The filters provide a high level of rejection to out-of-band interferers, protecting the transceiver from high blocking signal levels and to support 3GPP LTE blocking test conformance. The Rx low-pass filters are cascaded with the low throw count switch to establish a lower insertion loss and noise figure than conventional LTE receivers.

## Auxiliary Paths

The two AUX ports are additional broadband ports that can be used symmetrically for either Tx or Rx operation. The AUX ports can support conventional GSM power levels.

## Smart Biasing

For most IoT applications, the DC-DC converter might not be available to control the VCC supply of the PA. With a fixed DC supply, Smart Biasing allows for easy power control through the MIPI interface by programming reduced bias current for lower gain states. Based on the application, a set of 4 to 6 different bias conditions with specific fixed-gain steps are predefined. For each of the steps, the transceiver output power can be adjusted to meet the desired total output power.

The key advantages of the smart biasing scheme are:

- Saving current consumption during lower output power operation
- Easy programming of fixed-gain steps through the MIPI interface
- Reducing the required output dynamic range of the transceiver.

## MIPI RFFE Controller Interface

The SKY68001-41 functional operation is fully controllable by a single MIPI interface that is used to drive the PA in various optimized bias modes as well as providing band selection and controlling the antenna switch Tx, Rx, and band selection.

Figure 1 shows the block diagram for the SKY68001-41.

## Ordering Information

| Part Number | Product Description                     | Evaluation Board Part Number |
|-------------|-----------------------------------------|------------------------------|
| SKY68001-41 | LTE Multi-Band Front-End Module for IoT | SKY68001-41EK1               |

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