Ultralow Loss GSM Quad-Band Antenna Switch Module

CXG1180EQ/1186EQ

Multiband support to allow the use of the multiple frequencies that are used in different countries is now standard in GSM terminals, which are now the most widely used terminal worldwide. Thus there are especially strong desires for miniature, low-cost, low-loss devices that can switch between multiple circuits with differing frequencies. The newly-developed CXG1180EQ and CXG1186EQ are high-performance lead frame modules that achieve those requirements in a balanced manner.

The GSM/UMTS dual mode CXG1190EQ/AEQ products introduced in CX-News Volume 38 are also high-performance lead frame modules.

- **Ultralow insertion loss: 0.70 dB in the GSM 850/900 Tx path and 0.85 dB in the DCS/PCS Tx path**
- **Dual low-pass filters: Attenuation 30 dB typical (GSM Tx 2fo, DCS/PCS Tx 2fo)**
- **Lead frame module that adopts a mold array package**
- **Miniature low-height package: LQFN-28P-01 (4.5 mm × 3.2 mm × 1.3 mm max.)**

Switching Structure that Achieves Low Insertion Loss

Insertion loss is an important index for switch performance. This parameter contributes significantly to both current consumption during transmission and reception sensitivity in portable terminals. Switch modules using the conventional LTCC* substrate adopted a structure in which the frequency band was divided into a low band (900 MHz band) and a high band (1800/1900 MHz band) using a diplexer, and after that, the path switches were connected. (See figure 1.) In these products, Sony adopted the SP6T switch structure to achieve low loss. These devices also provide a low-pass filter in the GSM Tx path. (See figure 2.) In the conventional LTCC module structure, the insertion loss for all the paths becomes the sum of the losses for the diplexer and the path switching switch. As a result, the overall loss was quite large.

In contrast, in the SP6T structure, only the switch insertion loss occurs in the paths other than the GSM Tx path, thus achieving low loss. Low loss can be achieved for the GSM Tx path as well, since the LPF can be implemented with a lower insertion loss than the diplexer. Furthermore, these devices achieve ultralow loss and low distortion by using GaAs switches implemented using Sony's unique JPHEMT process as the switching devices.

*: LTCC: Low temperature co-fired ceramic

Lead Frame Module

In conventional antenna switch modules used in GSM terminals and other products, the switches are implemented by combining, on an LTCC, FR-4, or similar substrate, PIN diodes and other semiconductor switching elements and multiple passive devices inserted on the substrate. However, considering the demands for multimode and multiband operation, miniature low-height form factors, and lower costs in recent cellular phone products, it can easily be seen that it will be difficult to achieve these using these conventional structures. Sony's response to these issues was to use the mold array package, which uses lead frames and is an existing package technology. These new products are implemented by mounting, on the lead frame, both GaAs switches fabricated using Sony's unique JPHEMT process that achieves both high performance and high integration densities and high integration density filters using LTCC technology. By using existing package technology based on lead frames, it was possible to use current manufacturing and assembly equipment and processes, and thus Sony is able to supply quality products at low cost. Furthermore, since these products consist of two simple components, a GaAs switching IC and a low-pass filter, they have the advantage that the development TAT can be reduced.

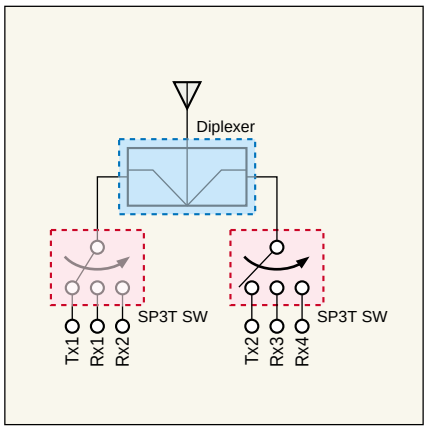
Miniature Low-Height Form Factor

The mounting area was reduced by integrating the two low-pass filters for the Tx paths (two circuits) into one component using LTCC technology. Also, etching technology can be used to perform complicated machining on the lead frame, which plays the role of interface between the switch and low-pass filter components mounted on the lead frame.

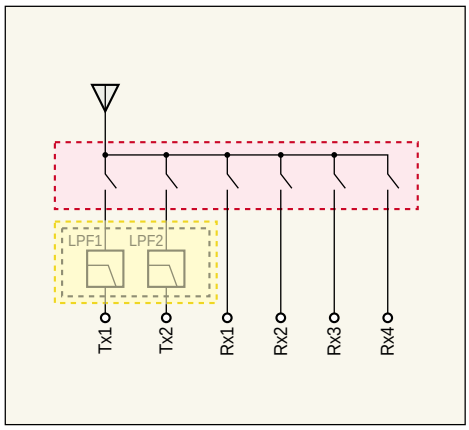
Furthermore, Sony optimized the contact area between the internal low-pass filter lands and the lead frame and also optimized the mold sealing thickness above the low-pass filters, thus achieving a miniature low-height form factor.

V O I C E

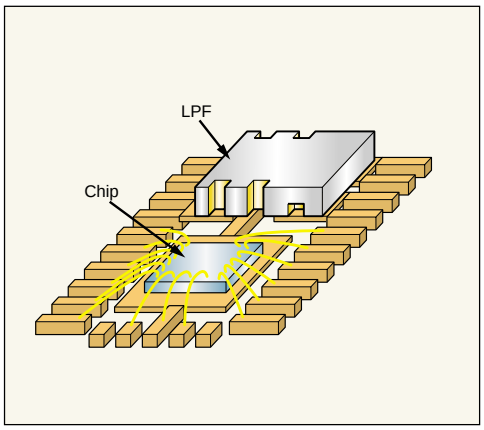
The CXG1180EQ and CXG1186EQ are antenna switches that feature low loss. While the function they provide is simple, this component has a large influence on the performance of radio transceivers. While this could be said to be excessive concern for such a small point, I hope this will contribute to our customers' creation of superb radio products.



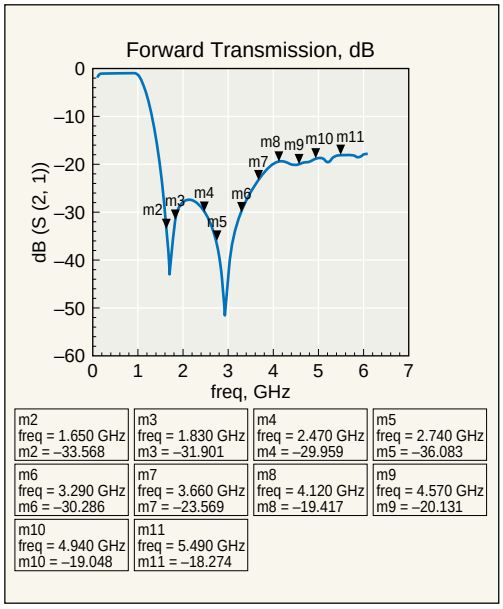
■ **Figure 1 Conventional Antenna Switch Module Block Diagram**



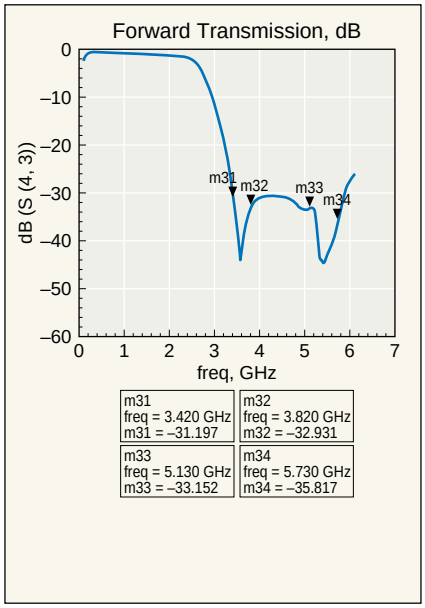
■ **Figure 2 CXG1180EQ/CXG1186EQ Block Diagram**



■ **Figure 3 Internal Structures Drawing**



■ **Figure 4 Low Band Low-Pass Filter Attenuation Characteristics**



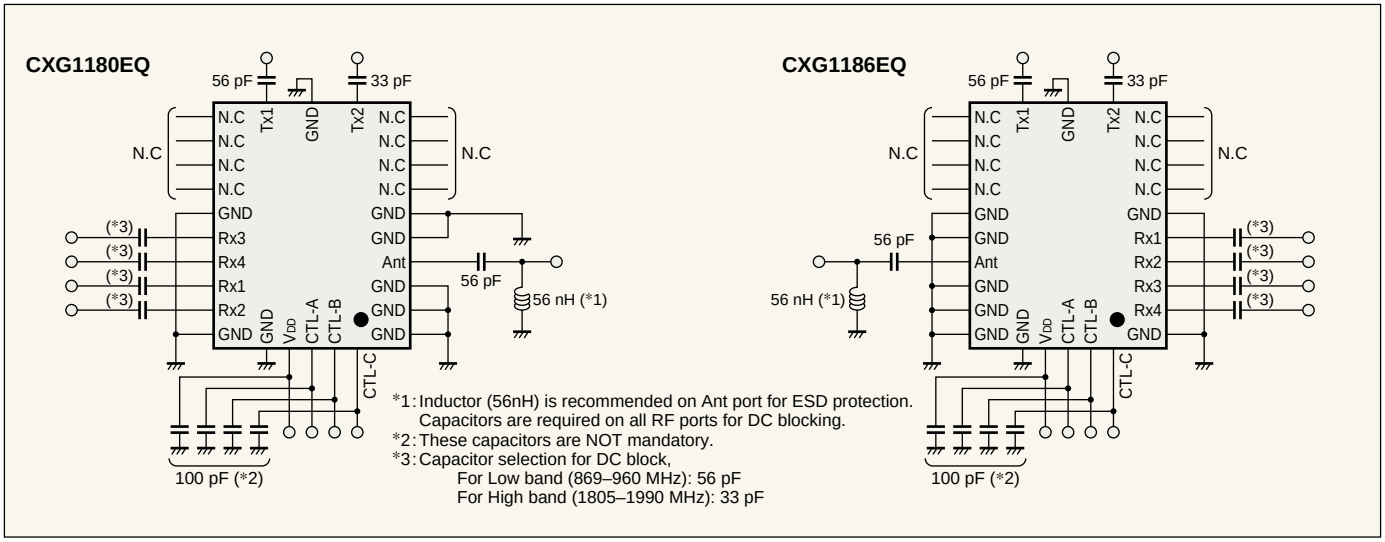
■ **Figure 5 High Band Low-Pass Filter Attenuation Characteristics**

■ **Table 1 Insertion Loss**

Ta = 25°C

Path	Condition	Insertion Loss (I.L)			Unit
		Min.	Typ.	Max.	
Tx1 – Ant	*1	—	0.70	1.00	dB
Tx2 – Ant	*2	—	0.85	1.15	
Ant – Rx1	*3/*4	—	0.65/0.85	0.85/1.10	
Ant – Rx2	*3/*4	—	0.65/0.85	0.85/1.10	
Ant – Rx3	*3/*4	—	0.65/0.85	0.85/1.10	
Ant – Rx4	*3/*4	—	0.65/0.85	0.85/1.10	

*1: Frequency = 900 MHz, Input Signal is CW, Pin = +34 dBm
*2: Frequency = 1910 MHz, Input Signal is CW, Pin = +32 dBm
*3: Frequency = 900 MHz, Input Signal is CW, Pin = –5 dBm
*4: Frequency = 1990 MHz, Input Signal is CW, Pin = –5 dBm



■ **Figure 6 Application Circuit Examples**