SAW Bandpass Filter for DECT

Application Note

Replaces July 1993 version, AN3833-1.2

AN3833-2.0 January 2000

SELECTION OF IF FREQUENCY:

The DW9249 is a S.A.W. Bandpass Filter designed specifically for use in Digital European Cordless Telephones (D.E.C.T.). A circuit schematic of a typical DECT receiver architecture is shown in Fig. 1. In this design a superhet philosophy is employed, using an Intermediate frequency (I.F.) at typically 110 to 112 MHz. Early designs of DECT receivers used 110.592 MHz but more recently this has been avoided owing to 6th or 8th harmonic leak through from either an 18.432MHz or 13.824 MHz reference oscillator. For this reason 112.32 MHz has now become a preferred standard.

DECT DESIGN CONSIDERATIONS:

The DW9249 operates at 112.32MHz and has an minimum operating 3dB bandwidth of 1200 KHz. The modulation rate and type specified within DECT demand an operating bandwidth of ±576 KHz under all conditions. Furthermore the DECT standard specifies a co-channel performance of 10dB and 15dB adjacent channel interference performance. These two requirements should be met allowing for all manufacturing, ageing and temperature tolerances. Overall allowance for these parameters, translates into a tight specification on the filter roll-off (shaping) characteristics.

An operating temperature range of -20°C to +85°C is recommended with a minimum requirement of 0°C to +40°C. It is for this reason that ST Quartz is used by Dynex Semiconductor as the substrate medium. Lithium Niobate based devices have extremely poor temperature performance with Lithium Tantalate being only marginally better. If the latter of these materials were to be employed then operational performance could only be guaranteed over the restricted temperature of 0°C to 40°C. For this reason Lithium Tantalate based devices have been primarily restricted to use in Test Systems enjoying a controlled climatic environment. On the other hand, the advantages from the use of Quartz as a substrate medium substantially improves the device manufacturability and co-channel/adjacent channel interference performance.

SAW FILTER DESIGN OPTIONS:

The next issue in the choice of design of Filter for DECT filtering has been the trade-offs between the demands for low Insertion Loss and low Group Delay ripple. Unlike many pure analogue communications systems, particular attention must be paid in digital communications to the phase or group delay ripple parameters of components. Phase distortion will

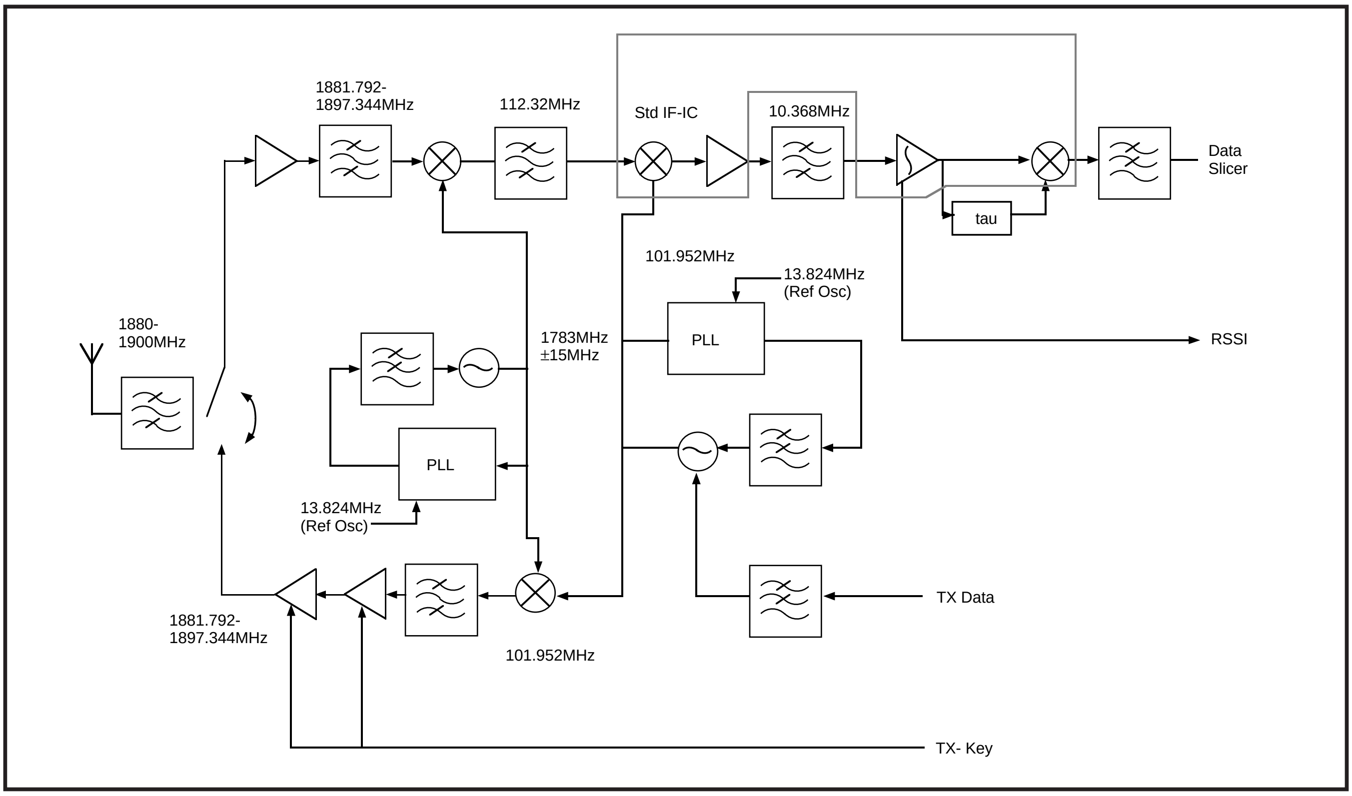


Figure 1: Block Diagram of a Typical 2GHz Radio

contribute directly to system Bit Error Rate (BER). Most DECT system designers have settled on an upper limit of allocation to the SAW filter group delay ripple at 300nS.

The choice is all the more complicated by the fact that SAW fillers can be realised in fundamentally one of two different ways: as Resonator filters or as Transversal filters. A comparison of the relative performance of SAW resonator and transversal filters is given in Table 1.

In brief, SAW Resonators can provide DECT system designs with low insertion loss filters hence reducing the gain and associated current consumption. This is achieved however at considerable expense overall on the system performance and manufacturability. Group delay ripple for a DECT based design resonator filter is typically five to ten times higher than that for a typical transversal filter at ambient. This figure can degrade further under full operating temperature conditions and time; matching impedances are highly sensitive; impedance matching networks are complicated by the need commonly to interface into an unbalanced mixer; co-channel rejection can be marginal against specification over the operating temperature range.

Saw bi-directional transversal filters on the other hand have an insertion loss of typically 14-16dB, and may require additional gain. However the filter has many compensating features including:

1. Excellent co-channel characteristics
2. Time and temperature stable matching impedances permitting simple, single element, fixed value matching components
3. Option for balanced or unbalanced drive networks
4. Exceptionally low group delay ripple
5. Operation over either the full or extended DECT temperature range
6. Good third order intercept point

In conclusion, Dynex Semiconductor recommend the adoption of a ST cut Quartz Transversal filter - DW9249 for use as an 112.32MHz IF filter in DECT receivers.

	ADVANTAGES	DISADVANTAGES
TRANSVERSAL FILTER DESIGN	V.Low Group Delay Ripple Stable Matching Impedances Balanced/Unbalanced Drive Good Stopband Rejection	Increased Insertion Losses Restricted Minimum Fraction Bandwidth >0.3% Increased Size
RESONATOR FILTER DESIGN	V.Low Insertion Loss V.Narrow Fractional Bandwidths Good Co-Channel Selectivity	V.Poor Group Delay Ripple Unbalanced Drive Option Only Mediocre Stop Band Rejection

Table 1: SAW Filter Technology Comparison

CIRCUIT MATCHING NETWORK:

Significantly, the SAW filter is designed asymmetric with the input and output impedances configured independently. Furthermore, the SAW frequency response is purposefully designed to have an asymmetric amplitude characteristic when measured unmatched in 50 ohms, but a symmetric amplitude when appropriately matched into the correct impedances. Two options for matching configurations are presented here:

1. Input: 50 ohms / Unbalanced drive
   Output: High Impedance IF Downconversion chip / Balanced drive

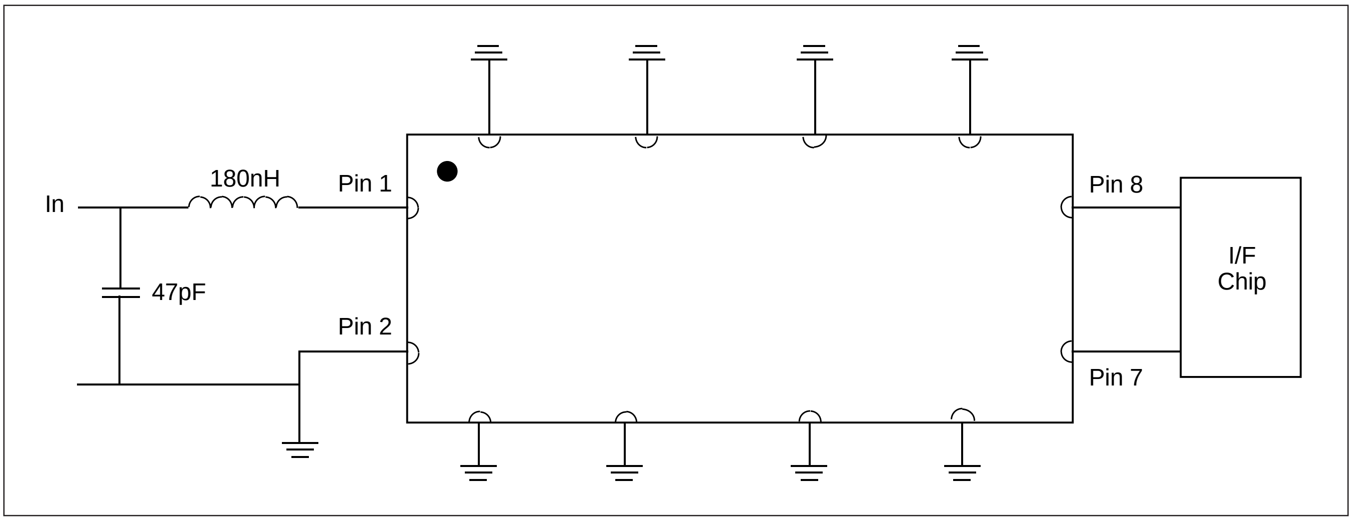


Figure 2

2. Input: 50 ohms / Unbalanced
   Output: 50 ohms / Unbalanced drive

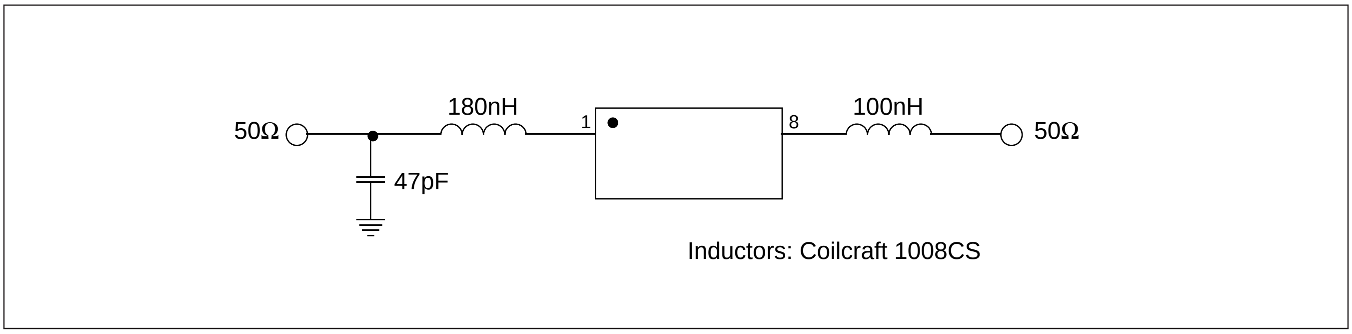
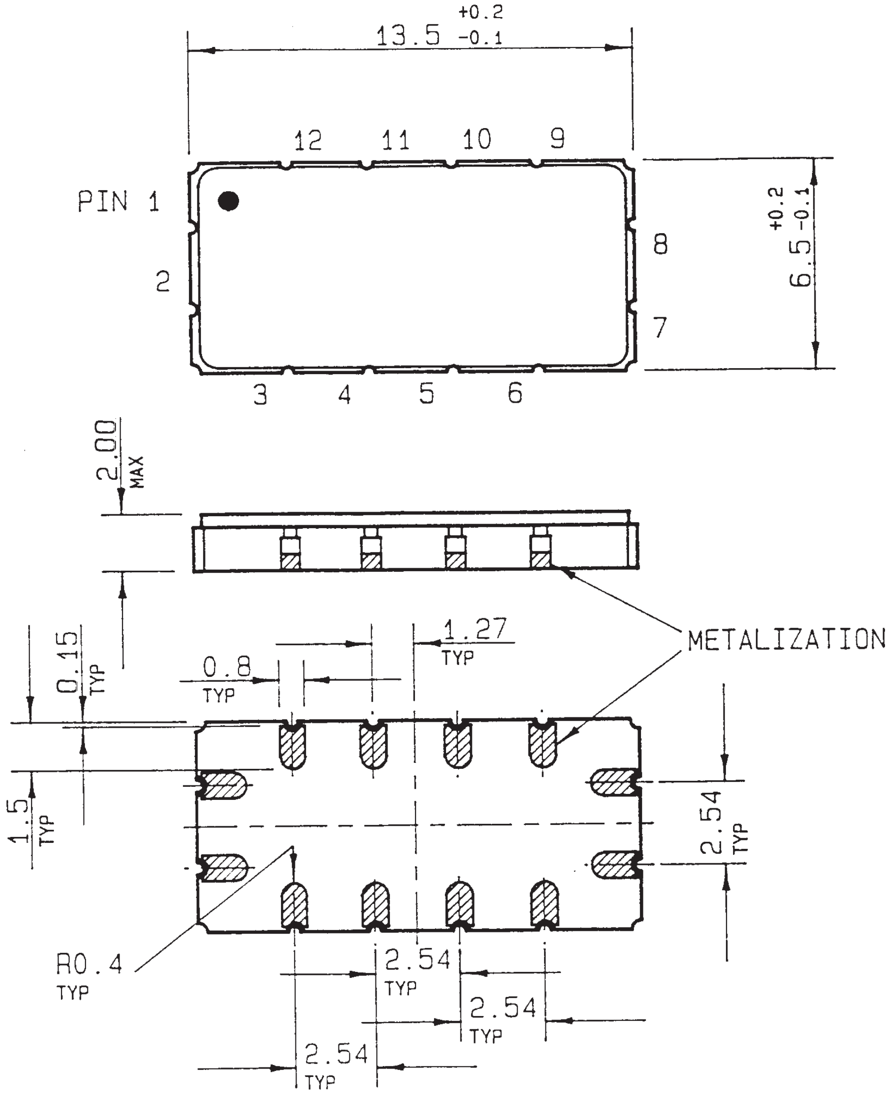


Figure 3

PACKAGE DETAILS



POWER ASSEMBLY CAPABILITY

The Power Assembly group was set up to provide a support service for those customers requiring more than the basic semiconductor, and has developed a flexible range of heatsink and clamping systems in line with advances in device voltages and current capability of our semiconductors.

We offer an extensive range of air and liquid cooled assemblies covering the full range of circuit designs in general use today. The Assembly group offers high quality engineering support dedicated to designing new units to satisfy the growing needs of our customers.

Using the latest CAD methods our team of design and applications engineers aim to provide the Power Assembly Complete Solution (PACs).

HEATSINKS

The Power Assembly group has its own proprietary range of extruded aluminium heatsinks which have been designed to optimise the performance of Dynex semiconductors. Data with respect to air natural, forced air and liquid cooling (with flow rates) is available on request.

For further information on device clamps, heatsinks and assemblies, please contact your nearest sales representative or Customer Services.

DYNEX SEMICONDUCTOR

http://www.dynexsemi.com

e-mail: power_solutions@dynexsemi.com

HEADQUARTERS OPERATIONS
DYNEX SEMICONDUCTOR LTD
Doddington Road, Lincoln.
Lincolnshire. LN6 3LF. United Kingdom.
Tel: +44-(0)1522-500500
Fax: +44-(0)1522-500550

CUSTOMER SERVICE
Tel: +44 (0)1522 502753 / 502901. Fax: +44 (0)1522 500020

SALES OFFICES
Benelux, Italy & Switzerland: Tel: +33 (0)1 64 66 42 17. Fax: +33 (0)1 64 66 42 19.
France: Tel: +33 (0)2 47 55 75 52. Fax: +33 (0)2 47 55 75 59.
Germany, Northern Europe, Spain & Rest Of World: Tel: +44 (0)1522 502753 / 502901.
Fax: +44 (0)1522 500020
North America: Tel: (613) 723-7035. Fax: (613) 723-1518. Toll Free: 1.888.33.DYNEX (39639) /
Tel: (949) 733-3005. Fax: (949) 733-2986.

These offices are supported by Representatives and Distributors in many countries world-wide.

Datasheet Annotations:

Dynex Semiconductor annotate datasheets in the top right hard corner of the front page, to indicate product status. The annotations are as follows:-

Target Information: This is the most tentative form of information and represents a very preliminary specification. No actual design work on the product has been started.

Preliminary Information: The product is in design and development. The datasheet represents the product as it is understood but details may change.

Advance Information: The product design is complete and final characterisation for volume production is well in hand.

No Annotation: The product parameters are fixed and the product is available to datasheet specification.