

# Product Engineering Specification

## K33365 (Black)

## K33332 (White)

## NanoX

### Product Information

**Product Name** NanoX

**Product Description** FM Transmitter for ipod

**Product Number** K33332 & K33365

**Product Manager** Betsy Diaz

**Project Manager** Matthew Hoag

### Introduction

This product will allow an ipod to transmit music to an FM receiver.

The ID of this product has been specifically designed to reference the Ipod Nano Dimensions.

#### 1.1 Scope

This document outlines the Electrical Specifications, ID Considerations, Mechanical Specifications and Tooling Requirements necessary to produce the product.

#### 1.2 Purpose

The purpose of this document is to assist the Contract Manufacturer in the production and testing of this product.

#### 1.3 Reference

- *Kensington Standards.doc*

#### 1.4 Acronyms

Table 1 - Acronyms

##### Acronym Description

ESD Electrostatic Discharge

EMC Electro Magnetic Compatibility

FCC Federal Communication Commission

### 2.0 Functional Specifications

The NanoX product contains an FM transmitter and a 3-position shuttle switch. This FM transmitter will connect to the ipod nano via the iPod's 30pin dock connector and will receive 3.3VDC for power and Line Out stereo for audio transmission. The FM transmitter must report itself as an FM transmitter in accordance to the iPod Omni and Audio/Remote Interface Specification's. An LCD is not required for this product

#### 2.1 General Description

#### 2.2 System Diagram

#### 2.3 Button Functions

Pressing the shuttle switch in will activate the tuning system.

Pressing the shuttle switch up briefly will increase the FM transmission frequency by 0.2.

Pressing the shuttle switch down briefly will decrease the FM transmission frequency by 0.2.

#### 2.4 Display Functions

This product will not use a display.

#### 2.5 Peripheral Devices Support

N/A

### 3.0 Electrical Specifications

The NanoX product is a FCC Part 15 compliant FM transmitter that connects to the iPod's "dock"

connector and transmits the iPod's music in FM Stereo. The NanoX receives Line Level audio for FM modulation and contains no charging components or batteries as it relies on the iPod's dedicated 3.3V accessory line for power. User interface options are restricted to a Tri-direction Scan Switch whose functions are dependent on the current Mode of the NanoX. In total, the NanoX contains 3 different Modes that will be defined in a later section. Since the NanoX interfaces with the iPod, the NanoX will be required to communicate with the iPod over a Serial Communication link. A brief mention will be provided in a later section. The innovative feature of the NanoX is the ability to use the iPod's display to convey user interface information. This feature requires the NanoX to follow the iPod Accessory Protocol Interface Specification as well as the iPod Extended Accessory Protocol Interface Specification.

### 3.1 Mode description

The NanoX operates in 3 different Modes:

- **Tuning Mode:** This is the first mode a user will see when the NanoX is first plugged into an iPod. In essence, this Mode replicates the LCD function of a standard FM transmitter in that it displays the current frequency and reacts appropriately to frequency changes defined by user inputs. The difference is that the NanoX uses the iPod's screen instead of a separate LCD display to convey this information. User input is provided by the use of the Tri-directional Scan Switch and it allows the user to adjust the transmitting frequency or switch Modes. It should be noted that during this mode, the NanoX is not transmitting. The following table lists the button functionality:

#### **Button during Tuning Mode Function**

Switch Up (Hold button for < 3 seconds)

Adjust transmitting frequency up 200 kHz. Refresh iPod display to add 0.2 MHz to current frequency.

Switch Up (Hold button for > 3 seconds)

Advance the transmitting frequency up in 200 kHz steps at fast speed. Refresh iPod's display to reflect the fast speed scan.

Switch Down (Hold button for < 3 seconds)

Adjust transmitting frequency down 200 kHz. Refresh iPod display to add 0.2 MHz to current frequency.

Switch Down (Hold button for > 3 seconds)

Advance the transmitting frequency down in 200 kHz steps at fast speed. Refresh iPod's display to reflect the fast speed scan.

Switch In (Hold button for < 5 seconds)

Go to iPod Mode

Switch In (Hold button for > 5 seconds)

Go to Preset Mode

- **Preset Mode:** This mode is activated only if the user holds the Scan Switch IN for more than 5 seconds while in Tuning Mode. When activated, this Mode allows the user to assign the frequency displayed in Tuning Mode to a Preset. This Mode is entered when the iPod display shows two new annunciators alternately flashing in addition to what was displayed during Tuning Mode. The flashing annunciators is a signal to the user to select a Scan switch position to assign as a Preset for the displayed frequency. When either the Up or Down Switch is

pressed, the NanoX will store the currently displayed frequency to that Switch position as a Preset. A successful store is signalled to the user by having the appropriate enunciator remain solid for 3 seconds before transitioning to iPod mode. From then on (until the preset button is reassigned), the appropriate annunciator is displayed whenever the frequency is displayed in Tuning mode. A Preset is recalled only when iPod Mode. It should be noted that during this mode, the NanoX is not transmitting. The following table list the button functionality:

### **Button during Preset Mode Function**

Switch Up Store currently displayed frequency

to the Up position as a Preset

Switch Down Store currently displayed frequency

to the Down position as a Preset

Switch In Go to iPod Mode

- iPod Mode: This Mode is where the NanoX is transmitting iPod stored music in FM Stereo on the frequency as determined by the Tuning Mode or by Presets. This is the only mode where FM transmission occurs as well as the only mode where Presets may be recalled. FM Transmission is achieved by the user pushing Play on the iPod. If the NanoX identifies itself correctly, it will transmit the iPod selected song on the appropriate frequency. Presets are recalled by having a user push the Scan Switch Up or Down for 5 seconds. A preset recall is deemed successful when the user either hears music on the FM receiver as the user has already tuned the receiver to the same frequency as the preset or, if the user no longer hears music on the previously transmitting frequency. The following table list the button functionality:

### **Button during iPod Mode Function**

Switch Up (Hold button for < 5 seconds)

Ignored.

Switch Up (Hold button for > 5 seconds)

Change NanoX transmitting frequency to Preset Up

Switch Down (Hold button for < 5 seconds)

Ignored.

Switch Down (Hold button for > 5 seconds)

Change NanoX transmitting frequency to Preset Up

Switch In Go to Tuning Mode

### **3.2 Serial Protocol Communication**

In accordance to the iPod Accessory Interface Specification, the NanoX must communicate with the iPod and report itself as an FM transmitter using the RF Transmitter lingo specification. Refer to the iPod Omni and Audio/Remote Interface Specification for the serial protocol details.

When the NanoX is in Tuning or Preset Mode, the NanoX will require to be in the Extended mode and use the commands found in the iPod Extended Accessory Interface Specification to change the iPod display. Refer to the iPod Extended Accessory Interface Specification for further details.

The iPod Specification revisions to use are as follows:

- iPod Accessory Interface Specification rev 20A
- iPod Extended Accessory Interface Specification rev 15

### **3.3 RF Characteristics**

- RF Frequency Range for USA: 88.1 – 107.9 MHz.
- RF Frequency Range for Japan: 76 – 90 MHz
- RF Step Size: 200 kHz
- RF Output Power: FCC mandated 250 uV/meter @ 3 meters maximum
- Signal Format: Standard FM Stereo Format
- RF Sensitivity: 9 dBf
- Selectivity: 75 dB

### **3.4 FM Transmitter Audio Characteristics**

The following performance metrics are to hold when the Transmitter output is tightly coupled to the antenna of the FM Test tuner.

- Frequency Range: 100 Hz – 15 kHz +/- 3 dB measured with broadband pink noise on 1/3 Octave or swept sine on logarithmic

- Stereo Separation: > 30 dB @ 88.1 MHz,
- Stereo Separation: > 50 dB @ 103.9 MHz
- Stereo Separation: > 50 dB @ 107.98 MHz
- SNR: > 55 dB full range
- THD: < 2.6% at 100 Hz measured at 1 Vrms
- THD: < 1.7% at 200 Hz measured at 1 Vrms
- THD: < 0.9% at 500 Hz measured at 1 Vrms
- THD: < 0.3% at 1000 Hz measured at 1 Vrms
- THD: < 0.1% at 2000 Hz measured at 1 Vrms

### **3.5 Operating Voltage**

- Voltage: 3.3VDC as per iPod spec
- Tx Current: < 30 mA

### **3.6 PCB Requirements**

- PCB Material: FR-4 (may change for RoHS requirements)
- Flammability Rating: 94V0

### **3.7 Antenna Length**

- Antenna length limited only by Kensington's ID

### **3.8 Design Files and BOM**

Please refer to provided Design files for Gerbers, schematics, layout, pick and place, BOM etc. Firmware is be provided in hex with the appropriate .TXT file for TI MSP430GANG programmer

## **4.0 Mechanical Specifications**

### **4.1 Industrial Design Considerations**

The width and depth of the product are identical to the iPod nano. Width=40mm, depth=6.9mm. The plastic enclosure and PCB assembly are designed so that when the device is connected to the iPod nano, the front, back and side surfaces of the two products are aligned.

Plastics and paints are color-matched with respective iPod nano.

Reveal line on product (joint between top and bottom covers) is to be aligned with the interface between top and bottom sections of iPod nano.

A false reveal is positioned in an area around the switch creating a distinct surface which is to be coated with soft-touch paint.

#### **4.1.1 Usability**

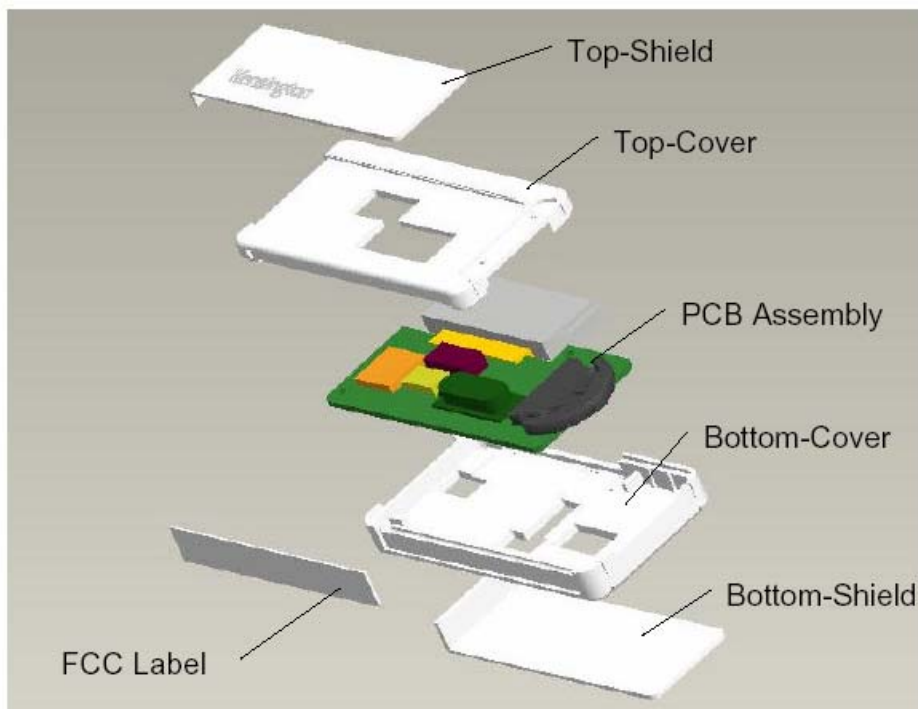
#### **4.1.2 Logos and Other Markings**

The Kensington logo will be pad printed on the front face of the product.

Product information, regulatory compliance marks and manufacturing location will be displayed on a label on the bottom surface of the product

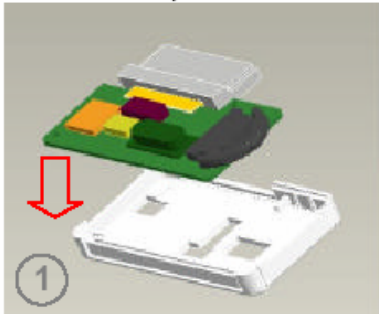
### **4.2 Component and Assembly Specifications**

The product is composed of 6 parts: Top Cover, Bottom Cover, PCB assembly, Top-Shield, Bottom-Shield and FCC Label.

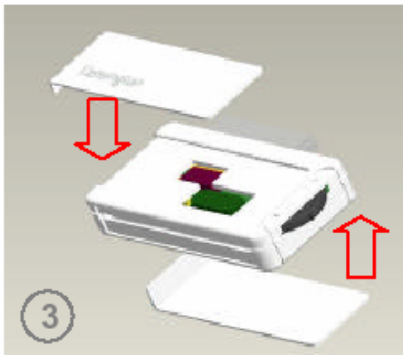
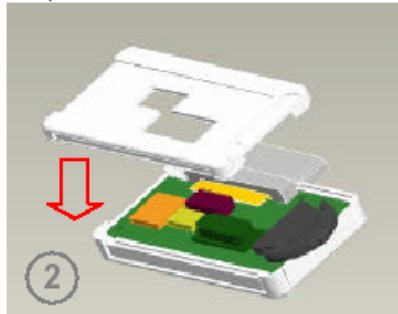


The PCB assembly is housed within an enclosure formed by the Top and Bottom Covers. The PCB assembly is located with crush ribs on the Bottom cover and is captured by ribs on the Top and Bottom Covers. Ultrasonic Welding is the primary construction method and is used to bond the Top-Cover to the Bottom-Cover. Double sided adhesive film is used to attach the Shield and Label components.

PCB assembly installed into Bottom Cover



Top Cover installed. Welded to Bottom Cover



Shields installed. Attached to assembly with two-sided adhesive film.



FCC label installed. Attached to assembly with two-sided adhesive film.

#### Design Summary

- Two-part enclosure encapsulates PCB assembly. Ribs locate and capture PCB.
- Ribs are sized so they do not result in sink marks on the exterior surfaces.
- Top and Bottom Cover components molded in *high quality PC+ABS* material.
- Top and Bottom Cover components include a small section around the switch, separated with a small reveal/groove that is to be coated with Soft-Touch paint prior to assembly.
- Top and Bottom Cover components are *ultrasonically welded* together to form enclosure.
- Proposed design uses '*energy director*' feature for *welded joint*. A shear joint weld could be used if preferred by Contract Manufacturer.
- The weld feature should withstand typical consumer use and the drop-test requirements.
- Melt from the welding process should not be visible from the outside and should not flow onto electronic components or traces on the PCB. *Trap features should be included if melt is expected to be excessive.*
- The reveal line surrounding the interface between enclosure components is offset toward front face of product so that it is aligned with the joint on the iPod nano.
- PCB assembly and 30pin connector are positioned within the housing such that the assembled product is flush with iPod nano on all surfaces when connected.
- Pass-through holes are located in the Top and Bottom Covers to allow clearance for tall electronic components.
- Shield components are used to cover the pass-through holes in the Cover components
- The 'Shield' concept is used rather than thinned sections above the tall components to eliminate the issue of sink marks.
- If PCB components are rearranged, tall components that require clearance features in the cover must be placed in an area underneath the Shield envelope.
- Shield components are formed from *Polycarbonate film* because they are too thin to mold
- The Shield components use clear PC film that is molded and back painted to match the corresponding plastic Cover material.

- The Top-Shield component is *pad-printed on the outside surface* with the Kensington logo
- Shield components are attached to the corresponding Cover component with *high strength double-sided adhesive*.
- The antenna exits through a hole in the bottom of the enclosure and resides in a groove along the base of the product.
- The antenna is covered with an *adhesive Polycarbonate label* that is printed with FCC identification and other information.

#### 4.3 Bill of Materials

The following BOM for the *black nano-X* product is a simplified version identifying the major components and processing related to the mechanical assembly.

| Part           | Description                      | Qty | Material   | Texture           | Colour                                 |
|----------------|----------------------------------|-----|------------|-------------------|----------------------------------------|
| K33365P        | NanoX-Black                      |     |            |                   |                                        |
| 150-0201-00    | Top-Cover, Masked and Painted    | 1   | Soft-Touch | Matte paint       | Clear Soft-touch                       |
| 160-1106-00-00 | Top-Cover, Molded                |     | PC+ABS     | Matte MT-11000    | Molded - Black (Match Black iPod nano) |
| 150-0203-00    | Bottom-Cover, Masked and Painted | 1   | Soft-Touch | Matte paint       | Clear Soft-touch                       |
| 160-1107-00-00 | Bottom-Cover, Molded             |     | PC+ABS     | Matte MT-11000    | Molded - Black (Match Black iPod nano) |
| 150-0199-00    | Top-Shield, Pad Printed          | 1   | Pad Print  | N/A               | Logo printed in Grey (Pantone xxx)     |
| 160-1105-00-00 | Top-Shield, Back-Painted         |     | Paint      | N/A               | Black to match black PC+ABS            |
| 160-1135-00-00 | Top-Shield, Molded               |     | PC         | Polished/Polished | Clear.                                 |
| 160-1136-00-00 | --Deleted--                      |     | -          | -                 | -                                      |
| 150-0207-00    | Bottom-Shield, Back-Painted      | 1   | Paint      | N/A               | Black to match black PC+ABS            |
| 160-1137-00-00 | Bottom-Shield, Formed            |     | PC         | Polished/Polished | Clear.                                 |
| 160-1138-00-00 | --Deleted--                      |     | -          | -                 | -                                      |
| 900-1383-00    | FCC Label                        | 1   | PC Label   | Matte/Polished    | Black label with grey text             |

|          |              |   |     |     |                                              |
|----------|--------------|---|-----|-----|----------------------------------------------|
|          |              |   |     |     | (Black-match PC+ABS color. Grey-pantone xxx) |
| 412-0267 | PCB assembly | 1 | N/A | N/A | N/A                                          |

The following BOM for the *white* nano-X product is a simplified version identifying the major components and processing related to the mechanical assembly.

| Part           | Description                      | Qty | Material   | Texture           | Colour                                                                  |
|----------------|----------------------------------|-----|------------|-------------------|-------------------------------------------------------------------------|
| K33332P        | NanoX-White                      |     |            |                   |                                                                         |
| 150-0200-00    | Top-Cover, Masked and Painted    | 1   | Soft-Touch | Matte paint       | Grey (Pantone 428) background, Clear Soft-touch                         |
| 160-1106-00-90 | Top-Cover, Molded                |     | PC+ABS     | Matte MT-11000    | Molded - White (Match White iPod nano)                                  |
| 150-0202-00    | Bottom-Cover, Masked and Painted | 1   | Soft-Touch | Matte paint       | Grey (Pantone 428) background, Clear Soft-touch                         |
| 160-1107-00-90 | Bottom-Cover, Molded             |     | PC+ABS     | Matte MT-11000    | Molded - White (Match White iPod nano)                                  |
| 150-           | Top-Shield, Pad Printed          | 1   | Pad Print  | N/A               | Logo printed in Grey (Pantone 428)                                      |
| 160-           | Top-Shield, Back-Painted         |     | Paint      | N/A               | White to match white PC+ABS                                             |
| 160-1135-00-00 | Top-Shield, Molded               |     | PC         | Polished/Polished | Clear                                                                   |
| 160-1136-00-00 | --Deleted--                      |     | -          | -                 | -                                                                       |
| 150-           | Bottom-Shield, Back-Painted      | 1   | Paint      | N/A               | White to match white PC+ABS                                             |
| 160-1137-00-00 | Bottom-Shield, Molded            |     | PC         | Polished/Polished | Clear.                                                                  |
| 160-1138-00-00 | --Deleted--                      |     | -          | -                 | -                                                                       |
| 900-           | FCC Label                        | 1   | PC Label   | Matte/Polished    | White label with grey text (White-match PC+ABS color. Grey-Pantone 428) |
| 412-0267       | PCB assembly                     | 1   | N/A        | N/A               | N/A                                                                     |

For a detailed Bill of Materials refer to the following documents:

Black - K33365P RevA nanoX (Black)

White - K33332P RevA nanoX (White)

#### 4.4 Material Specifications

##### *Top and Bottom Covers*

PC+ABS

- GE C2950 or equivalent
- Color-matched to respective iPod nano
- Parts to be free of contaminants, debris, burn marks or any visible blemishes.

##### *Shield*

Molded Polycarbonate

- Resin specification to be provided by CM.
- 500 micron (0.5mm) thickness
- No fillers or UV stabilizers
- Polished on both surfaces

Double-sided adhesive film (die-cut and applied to 'Shield' recess on 'Cover' components)

- 3M 467MP Hi Performance Adhesive or equivalent
- 200MP adhesive
- 2.3mils (0.06mm) thickness
- format and liner style to be determined by CM

##### *Label*

Polycarbonate film

- Bayer Makrofol DE 1-1D or GE Lexan 8010

- 250 micron (0.25mm) thickness
  - No fillers or UV stabilizers
  - Matte first surface, polished second surface
- Double-sided adhesive film (laminated with label material prior to die-cutting)
- 3M 467MP Hi Performance Adhesive or equivalent
  - 200MP adhesive
  - 2.3mils (0.06mm) thickness
  - format and liner style to be determined by CM

#### **4.5 Tooling Specifications**

- Multi-cavity, family mold tool used to create Top-Cover and Bottom-Cover at same time.
- Mold must be completely purged after production in one color before starting production of the other.
- Tools are guaranteed to run minimum of 350k shots/items
- Cavity steel grade: NAK80 (or a grade rated to reach minimal tool life of 350K cycles while maintaining specified texture, not requiring excessive tool maintenance and suitable for the injected material),
- Mold base steel grade: S55C or suitable production grade mold steel.
- Mold textures refer to part drawings.
- All molds to have adequate cooling channels for temperature control.
- In multi-cavity molds, all identical cavities should be individually identified.
- Where slides are required in to mold, the slide material must be different than the cavity material and have a different hardness value
- Contract manufacturer will be solely responsible for the design, layout and execution/build of the suite of tools for the purpose of producing volume production quantities of NanoX .
- Contract manufacturer is solely responsible for the safe keeping and on going maintenance of tools to facilitate continued production of product quality.
- Contract manufacturer will mark each tool with an identifying plate in English with the following information:
  - The property of Kensington a subsidiary of ACCO Brands Corporation.
  - Kensington part number
  - Mold number
- Contract manufacturer is responsible for any additional tooling costs needed to produce parts within tolerance or fitting range once after T1 shot is reviewed

#### **4.6 Compliance and Recycling Requirements**

All components must be designed and manufactured to comply with RoHS and WEEE standards.

#### **4.7 Product Labelling Requirements**

The Kensington logo will be pad printed on the front face of the product.

A document will be provided with instructions on location and size of logo

Product information, regulatory compliance marks and manufacturing location will be displayed on a label on the bottom surface of the product

A document will be provided with instructions on location and size of art work on label.

#### **5.0 Software Specifications**

Not applicable for this product.

#### **6.0 Product Packaging, Labelling and Documentation**

This product will use a six sided box with window, clamshell and coloured insert card.

##### **6.1 Packaging Name**

Six sided box.

##### **6.2 Box Structure Materials Specifications**

400ppt CC2S