



# TEF665X

DSP-based radio tuner one-chip

Rev. 1 — 30 July 2013

Product short data sheet



## 1. General description

The TEF6657 and TEF6659 are single-chip radio ICs including an AM/FM radio tuner and software-defined radio signal processing. These devices are the successors to the industry-proven TEF661X product range, with improved performance and feature set at lower system cost.

Both devices are available in HVQFN packages occupying only smallest PCB real estate and are suitable for multi-layer PCBs.

The radio receiver includes the FM/AM front-ends, tuning synthesizer, channel filtering, FM multipath improvement, demodulation, FM stereo decoding, weak signal processing, noise blanking, RDS and DARC support.

Stereo audio is provided in digital format on the I<sup>2</sup>S outputs and on the audio DAC outputs.

The TEF6659 supports the HD Radio and Digital Radio Mondiale (DRM) digital radio standards when used with NXP Semiconductors' digital radio coprocessors such as SAF356X and SAF360X.

## 2. Features and benefits

- Alignment free digital receiver including tuner and software-defined radio processing
- Command based high-level user interface combining high control flexibility with ease of control
- Read information with device and tuning status, reception quality and RDS data
- FM receiver with a tuning range of 65 MHz to 108 MHz covering Eastern Europe (OIRT), Japan, Europe and US bands
- AM receiver covering LW, MW and full SW
- Fully integrated tuning system with low phase noise and fast tuning
- FM LNA with AGC
- FM mixer for frequency conversion to a low IF complex signal
- AM LNA with AGC, matching active and passive antenna applications
- AM mixer for frequency conversion to a low IF complex signal (AM SW)
- High dynamic range IF ADC
- Digital IF signal processing including decimation, shift to baseband, AGC control, I/Q correction, variable IF bandwidth filtering (PACS) and demodulation
- FM stereo decoding



- Baseband I<sup>2</sup>S output supporting HD Radio and DRM<sup>1</sup> with external digital radio coprocessor (TEF6659)
- Blending function for HD Radio reception (TEF6659)
- AM & FM noise blanking, Signal quality detection and weak signal processing
- Advanced RDS and RBDS demodulation and decoding
- MPX output supporting DARC demodulator
- One I<sup>2</sup>S input and one I<sup>2</sup>S output
- Two mono audio DACs
- Single 3.3 V supply voltage
- Fast mode I<sup>2</sup>C-bus (400 kHz)
- Configurable GPIO pins for RDS, Quality Status Interrupt and generic I<sup>2</sup>C-bus controlled I/O
- Qualified in accordance with AEC-Q100

### 3. Applications

The TEF665X is a single tuner AM/FM receiver for automotive applications and supports analog AM/FM and HD/DRM reception (HD/DRM is supported in TEF6659 only).

Additionally, due to a common technology platform, the TEF665X can be combined with TEF701X, SAF775X and SAF360X for optimal system application through common crystal oscillator sharing.

### 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Supply voltage</b>						
V <sub>DDA(RF)(3V3)</sub>	RF analog supply voltage (3.3 V)	on pin VDDA_RF	3.0	3.3	3.5	V
V <sub>DDA(IF)(3V3)</sub>	IF analog supply voltage (3.3 V)	on pin VDDA_IFADC	3.0	3.3	3.5	V
V <sub>DDD(3V3)</sub>	digital supply voltage (3.3 V)	on pin VDD_DIGITAL	3.0	3.3	3.5	V
<b>Current in FM mode</b>						
I <sub>DDA(RF)</sub>	RF analog supply current	on pin VDDA_RF	33	37	42	mA
I <sub>DDA(IFADC)</sub>	IF ADC analog supply current	on pin VDDA_IFADC	81	94	110	mA
I <sub>DDD</sub>	digital supply current	on pin VDDD	37	38	48	mA
<b>Current in AM - MW/LW mode</b>						
I <sub>DDA(RF)</sub>	RF analog supply current	on pin VDDA_RF	34	40	48	mA
I <sub>DDA(IFADC)</sub>	IF ADC analog supply current	on pin VDDA_IFADC	63	74	86	mA
I <sub>DDD</sub>	digital supply current	on pin VDDD	33	34	46	mA
<b>Current in Standby mode</b>						

1. DRM includes DRM30 and DRM+ (band I and II)

Table 1. Quick reference data ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I <sub>DDA(RF)</sub>	RF analog supply current	on pin VDDA_RF	0	0.3	2	mA
I <sub>DDA(IFADC)</sub>	IF ADC analog supply current	on pin VDDA_IFADC	25	37	45	mA
I <sub>DDD</sub>	digital supply current	on pin VDDD	15	24	35	mA

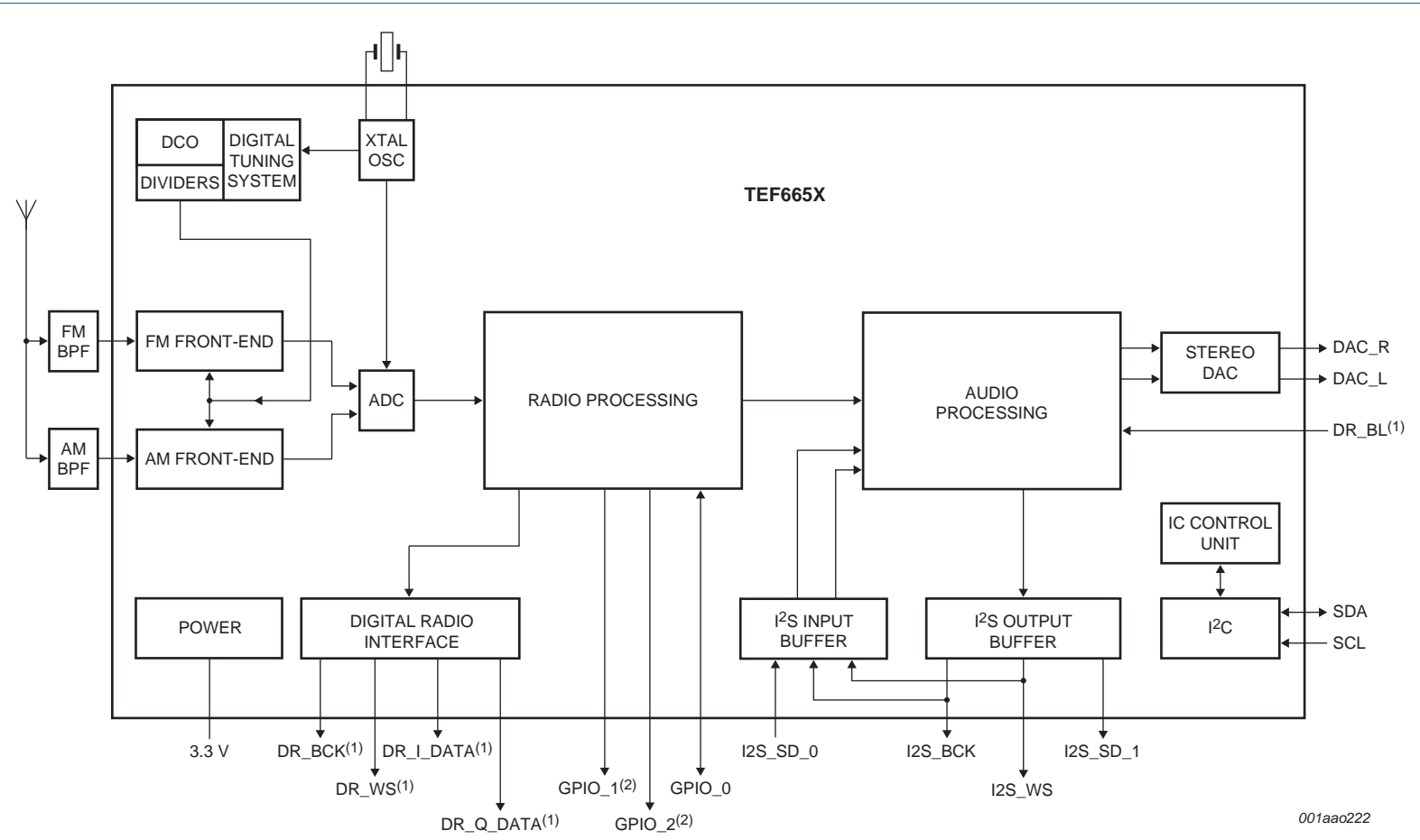
## 5. Ordering information

Table 2. Ordering information

Type number	Package		Version
	Name	Description	
TEF6657HN/V101	HVQFN32	plastic thermal enhanced very thin quad flat package; no leads; 32 terminals; body 5 × 5 × 0.85 mm <sup>[1]</sup>	SOT617-3
TEF6659HN/V101			

[1] Wettable sides to allow for optical inspection.

## 6. Block diagram



001aa0222

- (1) TEF6659
- (2) GPIO\_1 and GPIO\_2 are output only.

Fig 1. Block diagram

## 7. Limiting values

**Table 3. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DDA(RF)(3V3)}$	RF analog supply voltage (3.3 V)	on pin VDDA_RF	-0.5	+3.9	V
$V_{DDA(IF)(3V3)}$	IF analog supply voltage (3.3 V)	on pin VDDA_IFADC	-0.5	+3.9	V
$V_{DDD(3V3)}$	digital supply voltage (3.3 V)	on pin VDDD	-0.5	+3.9	V
$\Delta V_{DD(3V3-3V3)}$	supply voltage difference between two 3.3 V supplies	between pins VDDA_IFADC and VDDA_RF	-0.3	+0.3	V
$V_n$	voltage on any other pin		-0.5	$+V_{DDD(3V3)} + 0.3$	V
$I_{lu}$	latch-up current	all supply voltages below the maximum value	[1] -100	+100	mA
$V_{lu}$	latch-up voltage		-	$1.5 \times V_{DDD(3V3)}$	V
$T_{stg}$	storage temperature		-55	+150	°C
$T_{amb}$	ambient temperature		-40	+85	°C
$T_j$	junction temperature		-40	+125	°C

[1] In accordance with AEC-Q100-004.

## 8. Revision history

**Table 4. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
TEF665X_SDS v.1	20130730	Product short data sheet	-	-

## 9. Legal information

### 9.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

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## 11. Contents

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<b>1</b>	<b>General description</b> .....	<b>1</b>
<b>2</b>	<b>Features and benefits</b> .....	<b>1</b>
<b>3</b>	<b>Applications</b> .....	<b>2</b>
<b>4</b>	<b>Quick reference data</b> .....	<b>2</b>
<b>5</b>	<b>Ordering information</b> .....	<b>3</b>
<b>6</b>	<b>Block diagram</b> .....	<b>4</b>
<b>7</b>	<b>Limiting values</b> .....	<b>5</b>
<b>8</b>	<b>Revision history</b> .....	<b>5</b>
<b>9</b>	<b>Legal information</b> .....	<b>6</b>
9.1	Data sheet status .....	6
9.2	Definitions .....	6
9.3	Disclaimers .....	6
9.4	Licenses .....	7
9.5	Trademarks .....	7
<b>10</b>	<b>Contact information</b> .....	<b>7</b>
<b>11</b>	<b>Contents</b> .....	<b>8</b>

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