AMRI-1000

Mobile Navigation Interface IC for Navigation Pad Module

AVAGO TECHNOLOGIES

Data Sheet

Description

The AMRI-1000 is a low power multi mode navigation sense and interface IC designed for use with the AMRS and AMRT series of navigation pad modules to provide a mouse-like pointing solution for mobile applications.

In addition to mouse-like navigation, the AMRI-1000 combined with AMRS/AMRT navigation pads can be configured to operate as a four or eight-way switch, a joystick and a scroll wheel like input device. The IC also supports combination of mouse and joystick modes for new navigation experience of e.g. web pages providing precise link selection with fast panning of web pages.

The operating mode can be dynamically reconfigured to provide the best user navigation experience for any active application. For example, the user may select joystick mode for a game and scroll wheel mode for phone book scrolling, while menu navigation is done with the backward compatible 4-way switch mode – always optimized and user configurable for any application.

Versus competing solutions, the AMRI-1000 combined with Avago's AMRS/AMRT series navigation pads is unique in its ability to provide superior tactile feedback as well as multiple intuitive to use operating modes in a compact form factor.

Theory of Operation

The AMRS/AMRT series navigation pads are capacitance-based sensor modules. A sliding disk is held at a center position by a patent pending pseudo-spring system when the pointer is not being used. Cursor navigation is activated when contact with the slider is sensed.

The sliding disk may be moved in any direction with excellent tactile feedback provided by the pseudo-spring system. The on-screen pointer tracks the movement of the sliding disk providing a mobile navigation experience similar to that provided by a PC mouse.

A selection or clicking operation can be performed by fully depressing the sliding disk. A dome switch provides tactile feedback for this operation.

The IC is built in a TQFN package and provides its own internal clock.

Features

- 360 degree navigation
- Superior tactile response
- Integrated selection switch with tactile feedback moving with disk
- Dynamically Reconfigurable Multimode operation:

  Mouse mode,

  Analog Joystick mode,

  Hybrid Mouse/Joystick mode,

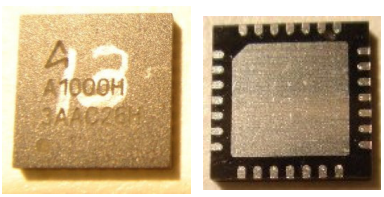
  4-way / 8-way rocker switch emulation modes,

  Scroll wheel mode
- Up to 250Hz screen update rate
- Internal clock
- 7 mW operating power1 (footnote: with 25% run rate while navigating)
- 200 uW standby power with wake on motion2 (footnote: with 1 Hz sampling rate)
- 30 µW power in shutdown mode
- 2.8V Supply Voltage
- 1.8V or 2.8V I/O Voltage
- Compact form factor in standard TQFN package
- Two-wire serial interface or 4-wire SPI interface (selectable)

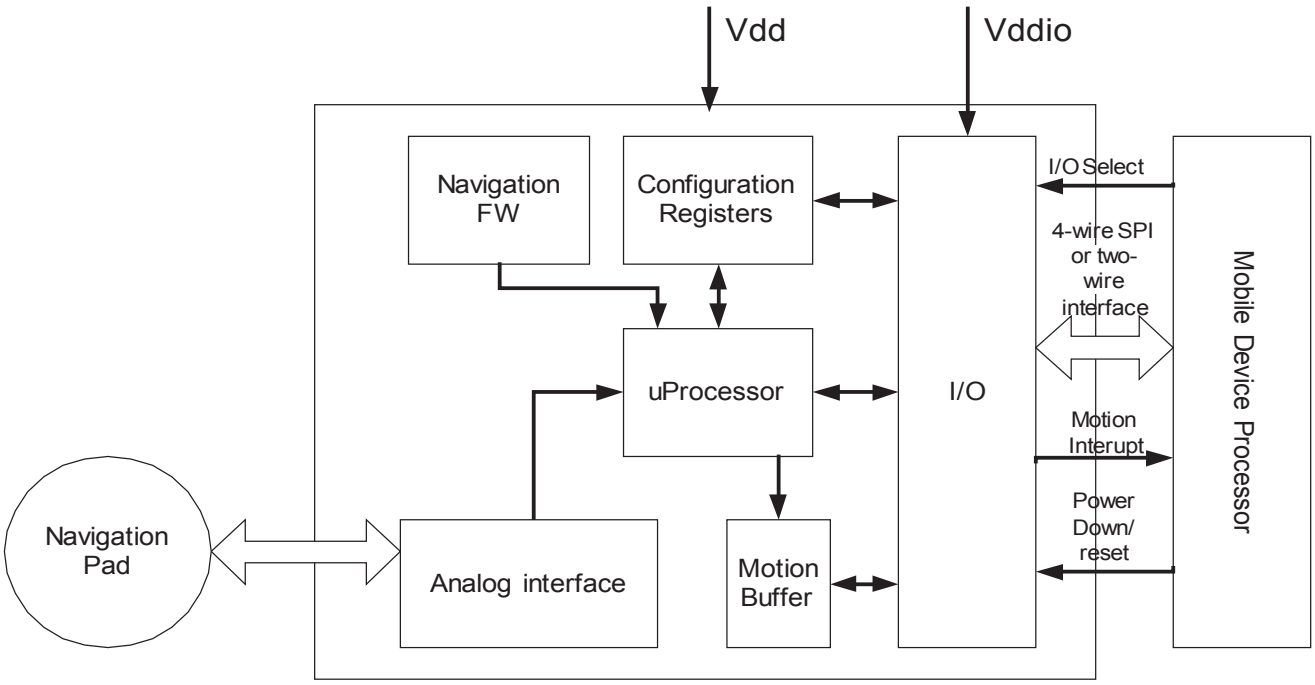
Applications

- Mobile Phones and Smart Phones
- Computer Peripherals
- Remote Controls
- PDAs, Sub-Notebook and Laptop PCs
- Mobile Multimedia Players
- Video Game Controllers

Component Image

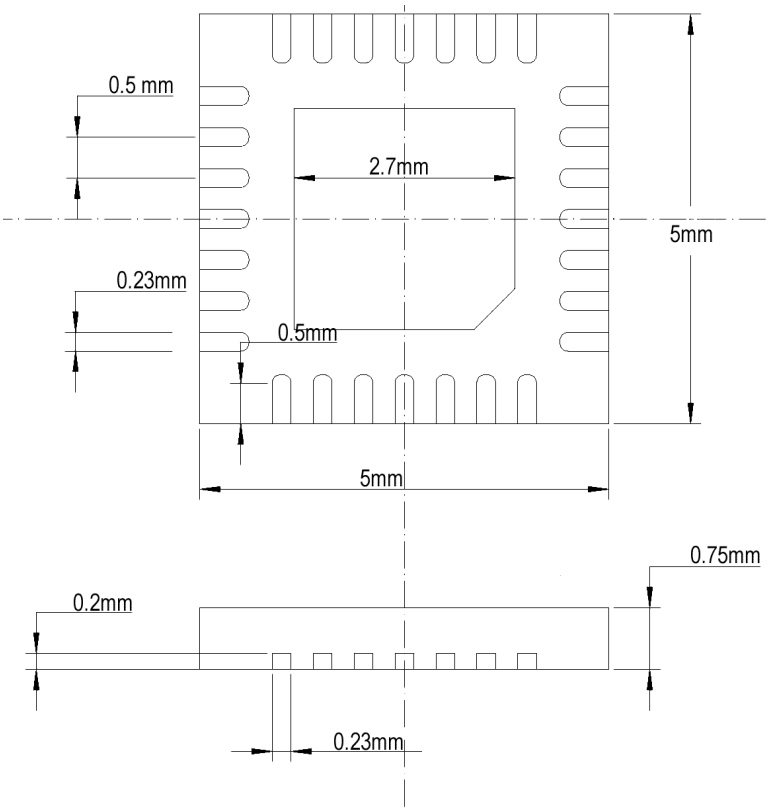


Block Diagram



IC Package (TQFN) and connections to navigation pad

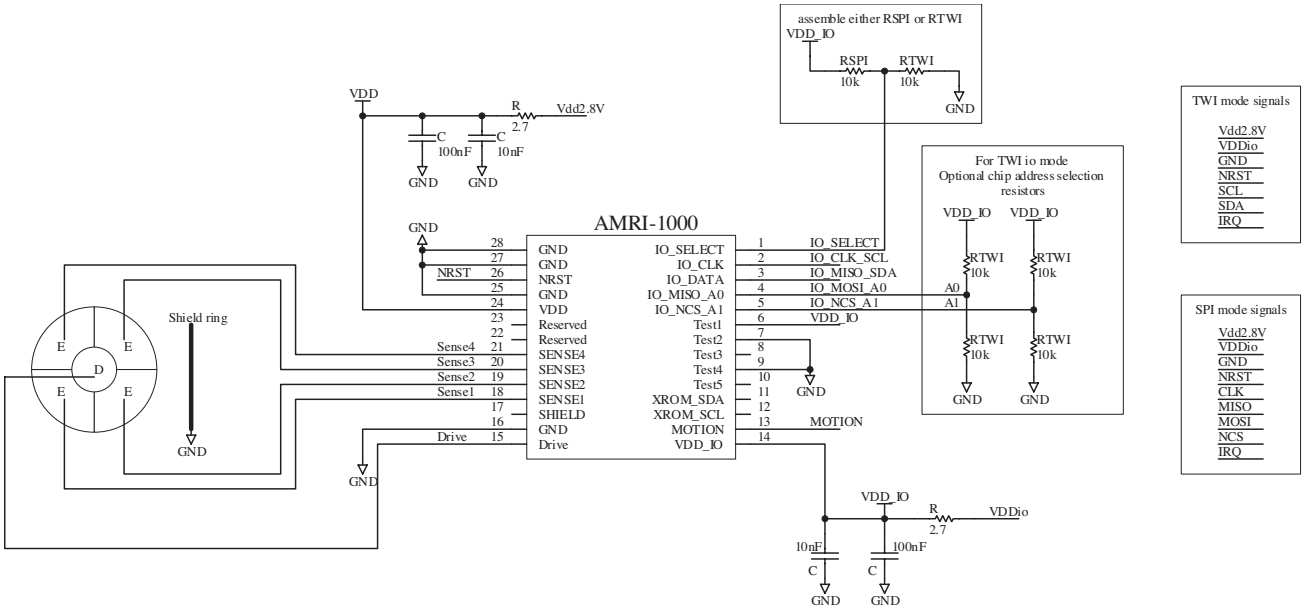
IC Dimensions (bottom and side view):



Pinout

Note: I/O = digital input/output A = analog P = power

Pin	Pin Name	SPI	Two-Wire interface (TWI)	I/O	Description
1	IO_SELECT			I/O	SPI/TWI Select High = SPI
2	IO_CLK	SCLK(I)	SCL (I)	I	Serial clock signal
3	IO_MISO_SDA	MISO(O)	SDA (IO)	I/O	TWI mode: SDA (Serial data) signal SPI mode: MISO (Master in Slave out) signal
4	IO_MOSI_A0	MOSI(I)	A0 (I)	I/O	Address select when used as TWI, addr[0], 3 states SPI mode: MOSI (Master out Slave in) signal
5	IO_NCS_A1	NCS (I)	A1 (I)	I	Address select when used as TWI, addr[1], 3 states SPI mode: nCS (Chip select) signal
6	Reserved			I	Connect to V_{DD}_IO 1.8V or 2.8V Nominal
7	Reserved			I	Connect to Ground
8	Reserved			O	No Connection
9	Reserved			I	Connect to Ground
10	Reserved			O	No Connection
11	XROM_SDA			I/O	If patch code required, connect to a EEPROM (e.g. 24A64) data (SDA) pin, else leave not connected
12	XROM_SCK			O	If patch code required, connect to a EEPROM (e.g. 24A64) clock (SCL) pin, else leave not connected
13	MOTION			O	Motion interrupt pin
14	V_{DD}_IO			P	Supply voltage for logic interface
15	DRIVE			O	Analog Drive to center electrode
16	GND			P	Connect to Ground
17	NC			A	No connection
18	SLIDER_SENSE1			A	Analog Sense
19	SLIDER_SENSE2			A	Analog Sense
20	SLIDER_SENSE3			A	Analog Sense
21	SLIDER_SENSE4			A	Analog Sense
22	Reserved			A	No connection
23	Reserved			A	No connection
24	V_{DD}			P	V_{DD} 2.8V Nominal
25	GND			P	Connect to ground
26	NRST_NSHD			I	Reset and shutdown
27	GND			P	Connect to ground
28	GND			P	Connect to ground



AMRI-1000 recommended application schematic

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units	Notes
Storage Temperature	T_S	-40	85	°C	
Operating Temperature	T_A	-25	70	°C	
Supply Voltage	V_{DD}	-0.5	3.6	V	
ESD			2	kV	All pins, human body model MIL 883 Method 3015
Input Voltage Transients	V_{TR}		+/- 0.3V	V	
I/O voltage	V_{IO}		V_{DD}_IO+0.3V	V	
Lead Solder Temp			260	°C	

Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Units	Notes
Operating Temperature	T_A	-25		70	°C	
Power supply voltage	V_{DD}	2.5	2.8	3.3	Volts	
I/O supply voltage	V_{DD}_IO	1.7	1.8/2.8	VDD	Volts	Supports 1.8V and 2.8V I/Os. I/Os must be below V_{DD}
Supply noise	V_N			50	mV	Peak to peak within 0-1 MHz bandwidth

DC Electrical Specifications

Electrical Characteristics over recommended operating conditions. Typical values at 25 °C, V_{DD} = 2.8 V, Default register values

Parameter		Symbol	Min.	Typ.	Max.	Units	Notes
System Current, run mode		I_{DD5}		8	12	mA	NAVG = 0x20
System current, rest modes		I_{REST}		Vdd=2.8V, Vddio=1.8/2.8V	Vdd/Vddio = 3.3V		
	Rest1			4.0/4.1	5	mA	Wakeup time ~20ms, Register 0x26 set to 0x05
	Rest2			0.5/0.6	0.9	mA	Wakeup time ~100ms, Register 0x2A default value 0x1D
	Rest3			0.07/0.07	0.1	mA	Wakeup time ~1s, Register 0x2E default value 0xFF
System Current, shutdown		I_{DD5N}		0.08	1.6	µA	
Resolution		RES	200	1000		counts	200 counts over full mechanical movement. +/-3mm slider travel is ~ 840 cpi resolution. DPISCALE register can increase effective cpi.
Input/Output Levels	Input High Voltage	VIH	-0.6		0.3	V	Voltage is relative to Vddio (0.65 Vddio per Jedec87)
	Input Low Voltage	VIL	-0.3		0.6	V	Voltage is relative to ground (0.35 Vddio per Jedec87)
	Output High Voltage	VOH	-0.2		0	V	Voltage is relative to Vddio (per Jedec87)
	Output Low Voltage	VOL	0		0.2	V	Voltage is relative to ground (per Jedec87)
	Output Low Current	IOL	-1.2			mA	at Vol
	Output High Current	IOH	0.6			mA	at Voh
Input Leakage Current				1.9	9.4	uA	
Input Offstate Leakage Current				0.02	0.04	uA	

AC Electrical Specifications

Electrical Characteristics over recommended operating conditions. Typical values at 25 °C, V_{DD}=2.8 V

Parameter	Symbol	Min.	Typ.	Max.	Units	Notes
Power up delay	T_{PUP}			25	ms	From the time V_{DD} reaches 2.8V until normal operation
Motion refresh rate	$F_{refresh}$			250	Hz	
Two-Wire Interface Speed				400	kHz	
4-wire SPI Interface speed				2	MHz	

Registers

Complete register definitions are under development

Address	Register Name	R/W	Default Value
0x00	PROD_ID	RO	0x80
0x01	hw_Rev_ID	RO	0x13
0x02	STATUS	RO	NA
0x03	Delta_X	RO	NA
0x04	Delta_Y	RO	NA
0x05	delta_Hi	RO	NA
0x07	intctl	RW	0x0C
0x08	IODL_CTL	RW	NA
0x09	IODL_DATA	RW	NA
0x0A	CAL_CONTROL	RW	0xC4
0x0C	calreset	RW	0x41
0x0E	BOOT_STAT	Rw	0x01
0x0F	FORCE_HI	R0	NA
0x10	FORCE_LO	RO	NA
0x11	MANUAL_CAL_CTL	RW	0x04
0x18	scrollctl	RW	0X09
0x20	Force_Run_Mode	RW	0x00
0x21	Obs_Run_Modes	RO	0x01
0x22	Run_HB	RW	0x1D
0x23	OSC_CTL	RW	0x03
0x24	REST1_DS_HI	RW	0x01
0x25	REST1_DS_LO	RW	0x90
0x26	REST1_HB	RW	0x1C
0x28	REST2_DS_HI	RW	0x01
0x29	REST2_DS_LO	RW	0x97
0x2A	REST2_HB	RW	0X1D
0x2C	REST3_DS_HI	RW	0xD2
0x2D	REST3_DS_LO	RW	0xF0
0x2E	REST3_HB	RW	0xFF

Address	Register Name	R/W	Default Value
0x35	HB_COUNT	R0	NA
0x39	ANA_GAIN_SPI	RW	NA
0x40	NAVMODE	RW	0x00
0x41	DPISCALE	RW	0x20
0x42	JOYSTICK_RAD	RW	0x0A
0x43	JOYSTICK_THRESHOLD	RW	0x64
0x44	DUAL_RAD	RW	0x14
0x45	DUAL_THRESHOLD	RW	0x32
0x46	ROCKER_SWITCH_RAD	RW	0x10
0x47	ROCKER_SWITCH_INCR	RW	0x20
0X48	DZ_RADIUS	RW	0x19
0X49	MOUSE_ZONE	RW	0x1E
0x4A	JOYSTICK_FAST_RAD	RW	0x28
0x4B	MAX_VEL	RW	0x32
0x4D	SENSE_MAP	RW	0XE4
0x5C	TOUCH_1_HI	RW	NA
0x5D	TOUCH_1_LO	RW	NA
0x5E	TOUCH_2_HI	RW	NA
0x5F	TOUCH_2_LO	RW	NA
0x60	ADCLIM_HI	RO	NA
0x61	ADCLIM_LO	RO	NA
0x62	CLICK_THRESHOLD_HI	RW	NA
0x63	CLICK_THRESHOLD_LO	RW	NA
0x66	TOUCH_3_HI	RW	NA
0x67	TOUCH_3_LO	RW	NA
0x6D	NAVG	RW	0x20
0x7A	Shutdown	WO	NA
0x7D	WD_DISABLE	WO	NA

For product information and a complete list of distributors, please go to our web site: **www.avagotech.com**

AV02-0553EN - July 5, 2007