Technical Overview

IPS Multi Space Parking Meter Controller Module

(MSCM)

RF Exposure Rules and Regulations:

- The system antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all the persons and must not be co-located or operating in conjunction with any other antenna or transmitter, except in accordance with FCC and Industry Canada multi-transmitter product procedures.

- The system antenna(s) used for this module must not exceed 10dBi (CDMA BC0) and 9.31dBi (CDMA BC1) for mobile and fixed operating configurations. Users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

The enclosed hardware device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received including interference that may cause undesired operation.

Warning (Part 15.21)
Changes or modifications not expressly approved by IPS Group, Inc. could void the user's authority to operate the equipment. Manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment.

Compliance Statement (Part 15.105(b))
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

• Reorient or relocate the receiving antenna
• Increase the separation between the equipment and receiver
• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
• Consult the dealer or an experienced radio/TV technician for help

Industry Canada (IC) regulatory information
This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie
Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Class B digital device notice
This Class B digital apparatus complies with Canadian ICES-003, RSS-Gen and RSS-210.
Cet appareil numérique de la classe B est conforme à la norme NMB-003, CNR-Gen et CNR-210 du Canada.

"To meet the host device labelling requirements, any host equipment incorporating the M800 module must include the FCC ID/IC certification number on the host as follows:

Contains FCC ID: SGWIPS2010M800
Contains IC: 11583A-IPS2010M800
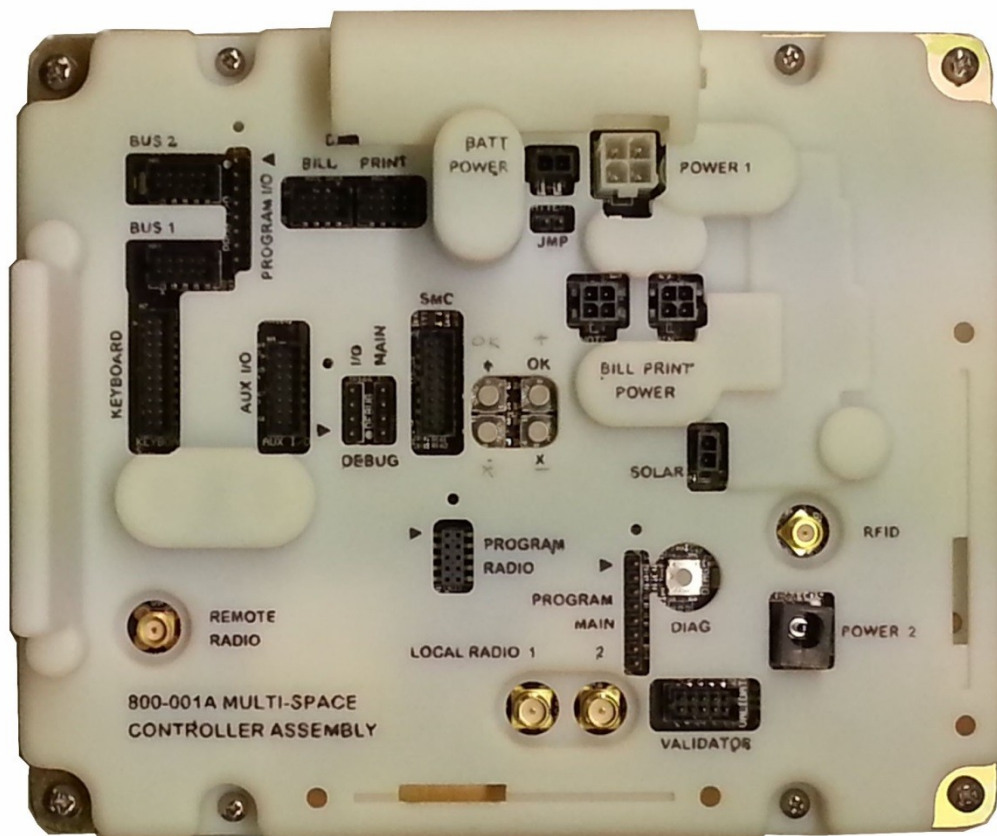Contains FCC ID: RI7UE910NA
Contains IC: 5131A-5131A-UE910NA"

IPS MSCM Overview

Module Description

This controller module is intended to be used across a number of IPS Multi Space Parking Meter platforms. These platforms include IPS designed multi space parking terminals as well as a number of existing designs that can be upgraded and retrofitted with this IPS technology. Parking terminals equipped with the MSCM may be configured as Pay and Display, Pay by Space, Pay by Plate and other configurations.
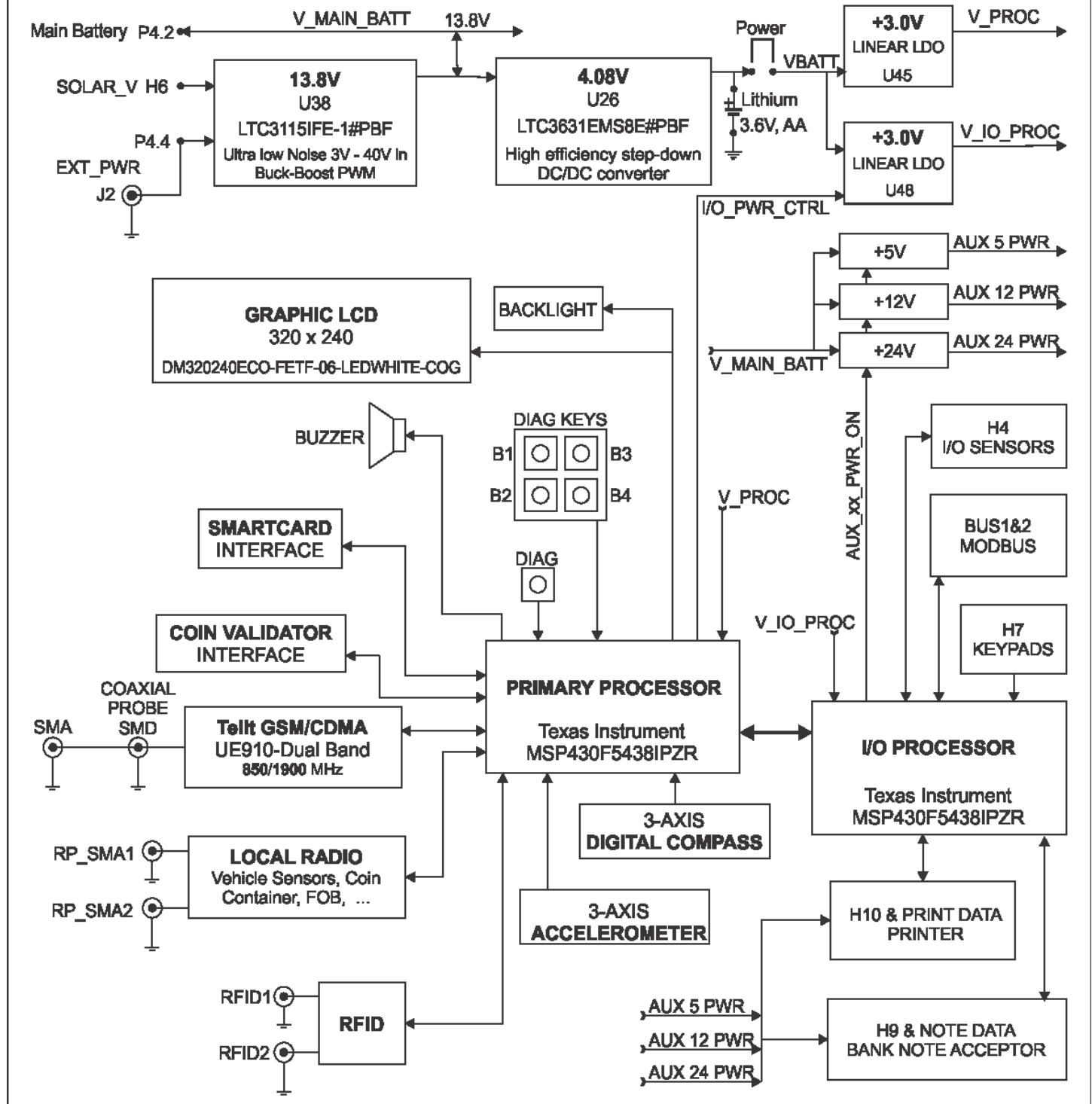
The MSCM consist of a large LCD display and a controller section enclosed in a protective mechanical housing. The controller PCBA supports a number of integrated features and interfaces to a number of optional peripheral units.

1 MSCM Rear View

Multi Space Controller Module Block Diagram

Main Battery P4.2 — V_MAIN_BATT — 13.8V

SOLAR_V H6

P4.4

EXT_PWR
J2

13.8V
U38
LTC3115IFE-1#PBF
Ultra low Noise 3V - 40V In
Buck-Boost PWM

4.08V
U26
LTC3631EMS8E#PBF
High efficiency step-down
DC/DC converter

Power
VBATT
Lithium
3.6V, AA

+3.0V
LINEAR LDO
U45 — V_PROC

+3.0V
LINEAR LDO
U48 — V_IO_PROC

I/O_PWR_CTRL

+5V — AUX 5 PWR
+12V — AUX 12 PWR
V_MAIN_BATT **+24V** — AUX 24 PWR

GRAPHIC LCD
320 x 240
DM320240ECO-FETF-06-LEDWHITE-COG

BACKLIGHT

BUZZER

DIAG KEYS
B1 ⚬ ⚬ B3
B2 ⚬ ⚬ B4

DIAG
⚬

AUX_xx_PWR_ON

V_PROC

H4
I/O SENSORS

BUS1&2
MODBUS

SMARTCARD
INTERFACE

COIN VALIDATOR
INTERFACE

COAXIAL
PROBE
SMA SMD

Telit GSM/CDMA
UE910-Dual Band
850/1900 MHz

V_IO_PROC

H7
KEYPADS

PRIMARY PROCESSOR
Texas Instrument
MSP430F5438IPZR

I/O PROCESSOR
Texas Instrument
MSP430F5438IPZR

RP_SMA1

RP_SMA2

LOCAL RADIO
Vehicle Sensors, Coin
Container, FOB, ...

3-AXIS
DIGITAL COMPASS

3-AXIS
ACCELEROMETER

H10 & PRINT DATA
PRINTER

RFID1

RFID2

RFID

AUX 5 PWR
AUX 12 PWR
AUX 24 PWR

H9 & NOTE DATA
BANK NOTE ACCEPTOR

Integrated Features and Interfaces

- Solar energy harvesting controller.
- 13.8V battery charger for external 12 VRLA battery.
- Low voltage supplies for internal use,
- 5V, 12V and 24V power supplies for external peripherals.
- Three MSP430 Mixed Signal Microcontrollers
- 4-way key pad diagnostic keypad
- Beeper for audible feedback
- GSM / CDMA Transceiver module for linkup to IPS servers
- C1190 Low Power 315/433/868/915 MHz ISM/SRD bands Transceiver for vehicle sensors, Coin Canister, etc.
- TRF7960RHBR 13.56-MHZ RFID Reader System
- Graphic LCD with controlled backlight
- Secondary low Voltage energy storage for backup and support*
- Smart Card Interface
- IPS Coin Validator Interface
- A 6x6 Keypad matrix for various keypad configurations.
- Two RS232 interfaces for Printers, Bank Note Acceptors, etc.
- 14 pin I/O connector for various sensors
- Two 10-way Multi Drop Bus connectors for communication between controller and peripherals such as coin handling units, down light and other controllers.

Theory of operation

Power Management

Solar energy is the standard power source for IPS Multi Space Parking Meters. Electrical energy is derived from high efficiency solar panels. This input energy is converted by the MSCM to levels suitable charging and maintaining an external 12V valve regulated lead acid (VRLA or sealed) battery system which in turn supplies power for internal power backup, internal circuits and external peripherals.

Long term power autonomy is achieved by switching systems off when not in use and by storing surplus energy in a high capacity VRLA battery. An average of one hour of sunshine per day is required to maintain this autonomy. This may vary as the requirements for its lighting systems, connectivity and usage change.

The MSCM provides an additional input for a nominal 12VDC input, normally derived from AC mains or other power systems, to support systems where sufficient solar energy is not available or internal heating elements need to be powered during very cold conditions.

Idle Mode

A number of configurable idle screens are displayed during idle mode to reassure and inform the potential user of the operational status of the unit, parking tariffs etc. Other systems, as defined by the configuration of the particular system, remain inactive to conserve energy. Events such an a person approaching the unit, pressing a key, inserting a coin or card or bank note will switch the unit to the active mode. The unit may also link up with the IPS managements systems during this mode if triggered by an alarm condition or to exchange data, configurations or software or to log any outstanding transaction details.

Active Mode

Active mode screens guides the user through the balance of the transaction proses related to the event that triggered this mode. The MSCM continuously manages the power and operation of the connected and configured peripherals. Connection to the backend systems via the GSM / CDMA interface may occur during this mode for card payment authorisations or alarm conditions. Active mode reverts to idle mode on completion of the transaction.

Diagnostic Mode

Access to this mode is via a diagnostic button on the back of the MSCM or the by the insertion of a valid diagnostic card. Navigation through the diagnostic menus is done via the four primary keypad buttons (+, -, cancel and OK) or via the equivalent four buttons on the back of the MSCM. Access to the diagnostic mode should be cancelled explicitly. A no-activity time out will also cancel this mode.

Cash Collection Mode

Cash collection is initiated by the insertion of a valid cash-collector's card and exchanging the coin box and or bank note stacker. This event is used to reset associated counters, establish a reconciliation point which is communicated to the back-end and to print a cash collection receipt if configured to do so. The receipt accompanies the coin box /canister and or bank note stacker as an additional security measure if required by the customer.

Primary and I/O Processors

Two linked Ti MSP430F5438 mixed signal microcontrollers form the Primary and I/O Processor pair.

The Primary Processor (U43) manages the functions normally associated with single space parking meters such as the user interface, coin validator, card reader, server (back-end system) access, wireless vehicle detection, wireless coin container communications, Host ID (RFID) detection and motion sensing.

The I/O Processor (U20) manages the additional functions associated with multi space parking meters such as the receipt printer, bank note acceptor different keypad configurations, coin handling units, expiry indicators, down light controllers and various cabinet sensors.

Full technical information falls outside the scope of this document and can be downloaded from
[www.ti.com/product/**msp430f5438**](www.ti.com/product/msp430f5438)

3-AXIS DIGITAL COMPASS

A Honeywell HMC5983 (U57) is a temperature compensated three-axis integrated circuit magnetometer and is used to sense the MSCM's orientation and motion.
http://www51.honeywell.com/aero/common/documents/myaerospacecatalog-documents/Defense_Brochures-documents/HMC5983_3_Axis_Compass_IC.pdf

3-AXIS ACCELEROMETER

The Xtrinsic MMA8453Q 3-Axis, 10-bit/8-bit Digital Accelerometer (U23) supplements and enhances the functions performed by the 3-axis digital compass (U57)
www.freescale.com/files/sensors/doc/data_sheet/MMA8453Q.pdf

I/O Sensors (H4)

This 14-way bus provides I2C comms, Connection for an external 25VP-P Piezo buzzer, and eight discrete switches to GND. The switches are used to sense the status of various doors and locks in the cabinet. To conserve power these lines

are not permanently powered (i.e. not pulled up) but rather pulsed periodically to sense its status. A 'high' will be read back from an internal sense capacitor if the switch is open and a ' low' if switched to GND.

MODBUS1&2 (MB1 & MB2)

These two linked headers provides controlled V_BAT (+3.6V) and V_MAIN_BAT (+12V) and a communication channel to a number of peripherals in a multidrug topology. Peripherals on this bus include a human proximity detector, expiry indicator, coin handling unit etc.

KEYPADS (H7)

H7 is a 20-way header providing V_BAT (+3.6V), V_KBD_BK_LED (switched +3.6V) for keypad backlighting and an 8-Col x 8-Row keypad matrix. This allows any number of keypads to be daisy chained and each keypad to be individually mapped to a 64 position key map.

Printer Power (H10) and Printer Data Port

The printer power header (H10) provides high capacity switched +5V, +12V and +24V suitable for supplying single or double sided thermal paper receipt printers.
The printer data port header provides a bidirectional RS232 communication link between the receipt printer and the MSCM.

Bank Note Acceptor Power (H9) and Note Data Port

The BNA power header (H9) provides high capacity switched +5V, +12V and +24V suitable for supplying Bank Note Acceptors (BNA's).
The NOTE DATA port header provides a bidirectional RS232 communication link as well as a logic level pulsed communication channel between the BNA and the MSCM.

Technical Specifications.

NOTE that power levels and frequencies are pre-set and cannot be reconfigured or retuned by the user.

Main Battery Connection

PARAMETERS	CONDITIONS	MIN	TYP	MAX	UNITS
Charge Voltage to Battery	Sufficient Solar or EXT Power		13.8		Volt
Charge Current to Battery	"			500	mA
Current Demand from Battery	Insufficient Solar or EXT Power		5		mA

Solar Input

PARAMETERS	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Required		6	12	38	Volt
Current Demand from Panel	Normal Operation Average		5		mA
	Backup Power Depleted			1000	

EXT Power Input

PARAMETERS	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Required		6	12	38	Volt
Current Demand from Source	Normal Operation Average		5		mA
	Backup Power Depleted			1000	

Auxiliary 5V Supply

PARAMETERS	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage		4.5	5.0	5.5	Volt
Available Output Current	Continuous		500		mA
	Peak for 100 ms			5000	

Auxiliary 12V Supply

PARAMETERS	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage		11	12	13	Volt
Available Output Current	Continuous		500		mA
	Peak for 100 ms			4000	

Auxiliary 24V Supply

PARAMETERS	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage		22	24	26	Volt
Available Output Current	Continuous		500		mA
	Peak for 100 ms			3000	

Graphic Display – General Specifications

ITEM	DESCRIPTION	UNIT
LCD type	FSTN Positive Transflective	-
Viewing Angle	6	O'clock
Module size (W×H×T)	136.6 × 176.0 × 5.0	mm
Viewing area (W×H)	120 × 82.65	mm
Viewing angle	6 O'clock	
Number of dots	320 × 240	dots
Dot size (W×H)	0.31 × 0.31	mm
Dot pitch (W×H)	0.325 × 0.325	mm
Backlight	LED, White	
Operating temperature	-4 to 185 -20 to 70	^{0}F ^{0}C

Backlight

ITEM	DESCRIPTION	UNIT
Technology	LED	
Colour	White	
Power Dissipation (MAX)	0.51	W
Forward Voltage (Typical)	3.1	V

Smart Card Interface

This 16-way proprietary interface connects the IPS Card Reader PCBA to the MSCM. Processed magnetic strip data as well as direct access to smartcard chip contacts is achieved through this contact.

Coin Validator Interface

This 10-way proprietary interface connects the IPS Coin Validator to the MSCM. This allows for analog and digital signals relating to the coin characteristics being analysed to be communicated to the MSCM for further processing.

GSM / CDMA

The primary component for this interface is the Telit **UE910-NAD** installed in U102. The UE910 is an HSPA 7.2 Mbps technology member of the xE910 family.

For further information visit http://www.telit.com/en/products/umts.php

UE910-NAD

ITEM	DESCRIPTION
All UE910 variants are dual-band GSM/GPRS/EDGE and dual band UMTS/HSPA	
Features	• Advanced E-GPRS/WCDMA/HSDPA/HSUPA Software protocol stack (Layer 1 to 3) – Version: 3GPP Release 7 • GSM Quad band (900/1800 MHz for EUx, 850/1900 MHz for NAx) • WCDMA dual-band: B1&B8 for the EUx models and B2&B5 for the NAx models • HSDPA up 7.2Mbps • HSUPA up to 5.76Mbps • WCDMA up to 384kbps downlink/uplink • DTM (Dual Transfer Mode) • CPC (DRX/DTX) (Continuous Packet Connectivity) • DARP

	• Control via AT commands according to 3GPP TS27.005, 27.007 and Telit customized AT commands
	• Serial port multiplexer 3GPP TS27.010
	• SIM application Tool Kits 3GPP TS 51.014
	• Power consumption (typical values)
	  - Stand-by current 2G, DRX5, 1.1 mA
	  - Stand-by current 3G, DRX7, 1.2 mA
	• Output power
	  - Class 4 (2W) @ 850 / 900 MHz, GSM
	  - Class 1 (1W) @ 1800 / 1900 MHz, GSM
	  - Class E2 (0.5W) @ 850/900 MHz, EDGE
	  - Class E2 (0.4W) @ 1800/1900 MHz, EDGE
	  - Class 3 (0.25W) @ 850/900/1900/2100 MHz, WCDMA
	• Sensitivity:
	  - 109 dBm (typ.) @ 850 / 900 MHz (GSM)
	  - 110 dBm (typ.) @ 1800 / 1900 MHz (GSM)
	  - 111 dBm (typ.) @ 850/900/1900 / 2100 MHz (WCDMA)

Data Transmission	• HSPA: category 8 in downlink e category 6 in uplink
	  - DL up to 7.2Mbps
	  - UL up to 5.76Mbps
	• WCDMA: up to 384kbps downlink/uplink
	• Asynchronous non-transparent CSD up to 9.6kbps
	• GPRS class 10 for NAx variants and class 33 for EUX variants
	• EDGE class 10 for NAx variants and class 33 for EUX variants
	• Coding scheme 1 to 4 (GPRS) & Modulation Coding scheme 1 to 9 (EDGE)

Approvals	• ⏹ Fully type approved confirming with R&TTE directive • ⏹ CE, GCF • ⏹ FCC, IC, PTCRB, • ⏹ RoHS (all versions)
Temperature Range	-40^{0}F ~ +185^{0}F (-40^{0}C ~ +85^{0}C)
RoHS compliance	RoHS (Restriction of Hazardous Substances) directive of the European Union (EU directive 2011/65/EU)

Operating Frequency	The operating frequencies in GSM850, EGSM900, DCS1800, PCS1900, WCDMA modes are compliant to the 3GPP and WCDMA specifications.				
	Mode	Freq. TX (MHz)	Freq. RX (MHz)	Channels	TX - RX offset
	GSM850	824.2 ~ 848.8	869.2 ~ 893.8	128 ~ 251	45 MHz
	EGSM900	890.0 ~ 914.8	935.0 ~ 959.8	0 ~ 124	45 MHz
		880.2 ~ 889.8	925.2 ~ 934.8	975 ~ 1023	45 MHz
	DCS1800	1710.2 ~ 1784.8	1805.2 ~ 1879.8	512 ~ 885	95MHz
	PCS1900	1850.2 ~ 1909.8	1930.2 ~ 1989.8	512 ~ 810	80MHz
	WCDMA850 (band V)	826.4 ~ 846.6	871.4 ~ 891.6	Tx: 4132 ~ 4233 Rx: 4357 ~ 4458	45MHz
	WCDMA900 (band VIII)	882.4 ~ 912.6	927.4 ~ 957.6	Tx: 2712 ~ 2863 Rx: 2937 ~ 3088	45MHz
	WCDMA1900 (band II)	1852.4 ~ 1907.6	1932.4 ~ 1987.6	Tx: 9262 ~ 9538 Rx: 9662 ~ 9938	80MHz
	WCDMA2100 (Band I)	1922.4 ~ 1977.6	2112.4 ~ 2167.6	Tx: 9612 ~ 9888 Rx: 10562 ~ 10838	190MHz

Transmitter output power	The UE910 family transceiver output of GSM/GPRS mode in 850/900MHz bands are class 4 in accordance with the specifications which determine the nominal 2W peak RF power (+33dBm) on 50ohm. In the 1800/1900MHz bands are class 1 in accordance with the specification which determines the nominal 1W peak RF

	power (+30dBm) on 50ohm. The UE910 family transceiver output of EDGE mode in 850/900MHz bands are class E2 in accordance with the specifications which determine the nominal 0.5W peak RF power (+27dBm) on 50ohm. In the 1800/1900MHz bands are class E2 in accordance with the specification which determine the nominal 0.4W peak RF power (+26dBm) on 50ohm. The UE910 family transceiver output of WCDMA mode in 850/900/1900/2100MHz bands is class 3 in accordance with the specifications which determine the nominal 0.25W peak RF power (+24dBm) on 50ohm.		

	Band	Typical	Note
	GSM 850	-109.5 dBm	BER Class II < 2.44 %
	GSM 900	-109 dBm	BER Class II < 2.44 %
	DCS 1800	-110 dBm	BER Class II < 2.44 %
Sensitivity	PCS 1900	-109.5 dBm	BER Class II < 2.44 %
	WCDMA FDD B1	-111 dBm	BER < 0.1 %
	WCDMA FDD B2	-110 dBm	BER < 0.1 %
	WCDMA FDD B5	-111 dBm	BER < 0.1 %
	WCDMA FDD B8	-110 dBm	BER < 0.1 %

	ANTENNA REQUIREMENTS	
	Frequency range	Depending by frequency band(s) provided by the network operator, the customer shall use the most suitable antenna for that/those band(s)
	Bandwidth (GSM/EDGE)	70 MHz in GSM850, 80 MHz in GSM900, 170 MHz in DCS & 140 MHz PCS band
Antenna	Bandwidth (WCDMA)	70 MHz in WCDMA Band V 80 MHz in WCDMA Band VIII 140 MHz in WCDMA Band II 250 MHz in WCDMA Band I
For further information, please refer to the UE910 family Hardware User Guide	Gain	1.4dBi @900 and 3dBi @1800 1.4dBi @850 and 3dBi @1900 1.43 dBi (WCDMA)
	Impedance	50 ohm
	Input power	> 33dBm(2 W) peak power in GSM > 24dBm Average power in WCDMA
	VSWR absolute max	≤ 5:1 (limit to avoid permanent damage)
	VSWR recommended	≤ 2:1 (limit to fulfil all regulatory requirements)

	Nominal Supply Voltage	3.8V
Supply voltage	Operating Voltage Range	3.4 ~ 4.2V
	Extended Operating Voltage Range	3.1 ~ 4.5V

	UE910		
	Mode	Average (mA)	Mode Description
Power consumption	SWITCHED OFF		Module supplied but switched off
	Switched Off	180uA	
Depending on network configuration and not under module control	IDLE mode (WCDMA)		
	AT+CFUN=1	12.2	Normal Mode: full functionality of the module
	AT+CFUN=5	1.8	Full functionality with power saving; DRX7; Module registered on network can receive incoming calls and SMS
	IDLE mode (GSM/EDGE)		
	AT+CFUN=1	19	Normal Mode: full functionality of the module

	AT+CFUN=4	16.5	Module is not registered on network
	AT+CFUN=5	1.2	Full functionality with power saving; DRX9 (1.3mA in case of DRX5)
	Operative mode (WCDMA)		
	WCDMA Voice	152	WCDMA voice call (TX = 10dBm)
	WCDMA HSDPA (0dBm)	187	WCDMA data call (Cat 8, TX = 0dBm)
	WCDMA HSDPA (0dBm)	494	WCDMA data call (Cat 8, TX = 22dBm)
	Operative mode (EDGE)		
	EDGE 4TX+1RX		EDGE Sending data mode
	GSM 850/900 – G8	495	
	DCS 1800/ PCS1900 – G7	484	
	Operative mode (GSM)		
	CSD TX and RX mode		GSM VOICE CALL
	GSM850/900 CSD PL5	220	
	DCS1800/ PCS 1900 CSD PL0	167	
	GPRS 4TX+1RX		GPRS Sending data mode
	GSM 850/900 PL5	580	
	DCS1800/PCS1900 PL0	438	
Data Transmission capabilities	The UE910 family supports: • HSPA: D/L up to 7.2Mbps, U/L up to 5.76Mbps • Asynchronous non-transparent CSD up to 9.6kbps for GSM, 14.4kbps for WCDMA • EDGE Class 10 for NAx variants and Class 33 for EUx variants • Coding scheme 1 to 4 (GPRS) & Modulation Coding scheme 1 to 9 (EDGE)		
Local security management	The local security management can be done with the lock of Universal Subscriber Identity Module (USIM), and the security code will be requested at power-up.		

Local Radio

Based on the Ti CC1101 this sub-1 GHz transceiver designed for very low-power wireless applications. The circuit is mainly intended for the ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency bands at 315, 433, 868, and 915 MHz, but can also be programmed for operation at other frequencies in the 300-348 MHz, 387-464 MHz and 779-928 MHz bands.

This wireless system is used for data communications with nearby local systems such as the wireless coin canister electronics.

NOTE that power levels and frequencies are pre-set and cannot be reconfigured or retuned by the user.

ITEM	DESCRIPTION

RF Performance	• High sensitivity
	   • -116 dBm at 0.6 kBaud, 433 MHz, 1% packet error rate
	   • -112 dBm at 1.2 kBaud, 868 MHz, 1% packet error rate
	• Low current consumption (14.7 mA in RX, 1.2 kBaud, 868 MHz)
	• Programmable output power up to +12 dBm for all supported frequencies
	• Excellent receiver selectivity and blocking performance
	• Programmable data rate from 0.6 to 600 kbps
	• Frequency bands: 300-348 MHz, 387-464 MHz and 779-928 MHz

Analog Features	• 2-FSK, 4-FSK, GFSK, and MSK supported as well as OOK and flexible ASK shaping

ITEM	DESCRIPTION
	• Suitable for frequency hopping systems due to a fast settling frequency synthesizer; 75 µs settling time • Automatic Frequency Compensation (AFC) can be used to align the frequency synthesizer to the received signal centre frequency • Integrated analog temperature sensor
Digital Features	• Flexible support for packet oriented systems; On-chip support for sync word detection, address check, flexible packet length, and automatic CRC handling. • Efficient SPI interface; All registers can be programmed with one "burst" transfer • Digital RSSI output • Programmable channel filter bandwidth • Programmable Carrier Sense (CS) indicator • Programmable Preamble Quality Indicator (PQI) for improved protection against false sync word detection in random noise • Support for automatic Clear Channel Assessment (CCA) before transmitting (for listen-before-talk systems) • Support for per-package Link Quality Indication (LQI) • Optional automatic whitening and de-whitening of data
General	• RoHS compliant and no antimony or bromine • Suited for systems targeting compliance with EN 300 220 (Europe) and FCC CFR Part 15 (US) • Suited for systems targeting compliance with the Wireless MBUS standard EN 13757-4:2005

RFID

A Ti TRF7960RHBR is used read the RFID tags of the host housing and the interchangeable coin canisters.
A full datasheet is available at www.ti.com/lit/gpn/trf7960

NOTE that power levels and frequencies are pre-set and cannot be reconfigured or retuned by the user.

ITEM	DESCRIPTION

Features	• Completely Integrated Protocol Handling
	• Separate Internal High-PSRR Power Supplies for Analog, Digital, and PA Sections Provide Noise Isolation for Superior Read Range and Reliability
	• Dual Receiver Inputs With AM and PM Demodulation to Minimize Communication Holes
	• Receiver AM and PM RSSI
	• Reader-to-Reader Anti-Collision
	• Ultra-Low-Power Modes
	    ○ Power Down < 1 µA
	    ○ Standby 120 µA
	    ○ Active (Rx only) 10 mA

Standard	ISO 14443A ISO 14443B ISO 15693 ISO 180003
Operating Temperature	-40 to + 110 ^{0}C
Current Consumption	10 mA
Frequency	13.56 MHz

Crystals used

X2, X3, X5 32.768kHz Crystal Seiko SSPT7F-12.5PF20-R

STANDARD SPECIFICATIONS

Conditions without notice (Temperature: +25±2°C, DL: 0.1µW)

Item	Symbol	Specifications	Conditions / Notes
Nominal Frequency	f_nom	32.768kHz	
Frequency Tolerance	f_tol	$\pm20 \times 10^{-6}, \pm50 \times 10^{-6}$	
Turnover Temperature	T_i	+25±5°C	
Parabolic Coefficient	B	$(-3.5\pm1.0) \times 10^{-8}/°C^2$	
Load Capacitance	C_L	7.0 pF / 12.5pF	
Motional Resistance (ESR)	R_1	65kΩ max.	
Absolute Maximum Drive Level	DLmax	1µW	
Level of Drive	DL	0.1µW	
Shunt Capacitance	C_0	0.8pF typ.	
Frequency Ageing	f_age	$\pm3 \times 10^{-6}$	+25±3°C, First Year
Operating Temperature	T_use	−40°C to +85°C	
Storage Temperature	T_stg	−55°C to +125°C	Piece part basis

See Crystal Seiko SSPT7F-12.5PF20-R.pdf.

X4 CRYSTAL SMD 13.56MHz ECS-135.6-18-23A-EN-TR

OPERATING CONDITIONS / ELECTRICAL CHARACTERISTICS

PARAMETERS	CONDITIONS	ECX-64A			UNITS
		MIN	TYP	MAX	
Frequency Range		8.000		100.000	MHz
Frequency Tolerance	at +25°C			± 30 *	ppm
Frequency Stability	-10 to +70°C			± 50 *	ppm
Shunt Capacitance				7	pF
Load Capacitance	Specify in P/N	10	20	Series	pF
Drive Level				100	µW
Operating Temperature		-10		+70	°C
Storage Temperature		-55		+125	°C
Aging (Per Year)	@ +25°C ±3°C			±5	ppm

See ecx-64a_ecx-64cr.pdf

X1 26 MHz Crystal NX3225GA

NDK — Crystal Bridge to the Future

1	NDK Part Number	NX3225GA-26.000MHz-EXS00A-CG01972
2	NDK Specification Number	EXS00A-CG01972
3	Type	NX3225GA
4	Chipset Maker	TEXAS INSTRUMENTS
5	Application	Smart meter , Zigbee
6	Chipset Name	NA
7	Chipset Number	Smart meter: CC430 , Zigbee:CC1101
8	End User	Smart Grid market
9	Electrical Characteristics	
9.1	Nominal Frequency (f_{nom})	26.000 MHz
9.2	Overtone order	Fundamental
9.3	Frequency Tolerance	$\pm 20 \times 10^{-6}$ max. (+25 °C)
9.4	Frequency Versus Temperature Characteristics	$\pm 40 \times 10^{-6}$ max. (-40 ~ +85 °C) The reference temperature shall be +25 °C
9.5	Equivalent Series Resistance (R_r)	50 Ω max.
9.6	Shunt Capacitance (C_0)	1.2 ± 0.3 pF
9.7	Motional Capacitance (C_1)	4.8 fF ± 30 %
9.8	Motional Inductance (L_1)	7.8 mH ± 30 %
9.9	Pulling Sensitiviity	19.1×10^{-6} /pF ± 30 % (where C_L = 10 pF)
9.10	Maximum Drive Level	200 µW max.
10	Measurement Circuit	
10.1	Frequency Measurement	
10.1.1	Measuring Instrument	π-network (IEC)
10.1.2	Load Capacitance (C_L)	10 pF
10.1.3	Level of Drive	10 µW
10.2	Equivalent Resistance Measurement	
10.2.1	Measuring Instrument	π-network (IEC)
10.2.2	Load Capacitance (C_L)	Series
10.2.3	Level of Drive	10 µW
11	Operable Temperature Range	-40 ~ +85 °C
12	Storage Temperature Range	-40 ~ +85 °C
13	Dimension	

(Unit: mm)

Land Pattern (Typical)

Terminal Land Connection (Top View)

Cover — Alumina Ceramics

Base — Alumina Ceramics

Terminal — Tungsten Metalize

Au plating on Ni pre plating
Ni : plating 2 to 9µm
Au : Plating 0.3 to 0.7µm

TERMINAL
#1,#3:Crystal
#2,#4:No Connection
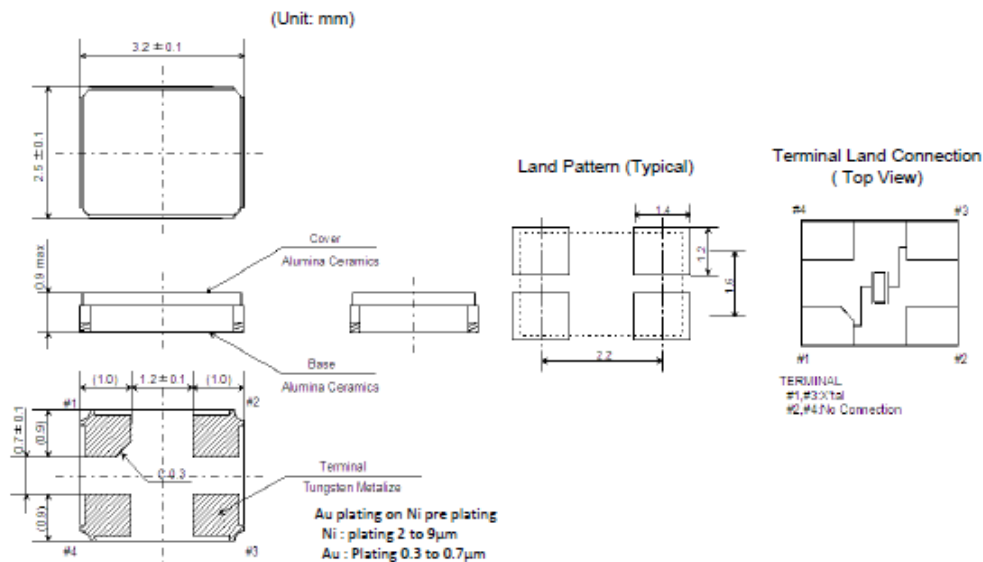
Jul.8.2010

See Crystal NX3225GA.pdf