73S8014RT
Smart Card Interface

Simplifying System Integration™

DATA SHEET

December 2008

ISO/IEC 7816-3

EMVCo

DESCRIPTION

The Teridian 73S8014RT is a single smart card (ICC) interface circuit. It is derived from the 73S8024RN industry-standard electrical interface but adds support for 1.8V smart card applications. The 73S8014RT has been optimized to match most of the typical Set-Top Box / A/V Conditional Access applications. Optimization essentially involved a smaller pin-count and support for single I/O.

The 73S8014RT has been designed to provide full electrical compliance with ISO 7816-3, EMV 4.0.

Interfacing with the system controller is done through a control bus, composed of digital inputs to control the interface, and one interrupt output to inform the system controller of the card presence and faults.

The card clock can be generated by an on-chip oscillator using an external crystal or by connection to an externally supplied clock signal. In addition, the clock divider provides divisor values of divide by 1, 2, 4 and 6.

The 73S8014RT incorporates an ISO 7816-3 activation/deactivation sequencer that controls the card signals. Level-shifters drive the card signals with the selected card voltage (1.8V, 3V or 5V), coming from an internal Low Drop-Out (LDO) voltage regulator. This LDO regulator is powered by a dedicated power supply input V_{PC}. Digital circuitry is powered separately by a digital power supply V_{DD}. With its embedded LDO regulator, the 73S8014RT is a cost-effective solution for any application where a 5V (typically -5% +10%) power supply is available.

Emergency card deactivation is initiated upon card extraction or upon any fault detected by the protection circuitry. The fault can be a card over-current, V_{CC} undervoltage or power supply fault (V_{DD}). The card over-current circuitry is a true current detection function, as opposed to V_{CC} voltage drop detection, as usually implemented in non-Teridian 8024 interface ICs.

The V_{DD} voltage fault has a threshold voltage that can be adjusted with an external resistor network. It allows automated card deactivation at a customized V_{DD} voltage threshold value. It can be used, for instance, to match the system controller operating voltage range.

APPLICATIONS

- **Set-Top Box Conditional Access and Pay-per-View**
- **General purpose smart card readers**

ADVANTAGES

- **Same advantages as the Teridian 73S80xxR family:**
  - Card V_{CC} generated by an LDO regulator
  - Very low power dissipation (saves up to 1/2W)
  - Fewer external components are required
  - Better noise performance
- **True card over-current detection**
- **Small format 20SO package**

FEATURES

- **Card Interface:**
  - Complies with ISO 7816-3, EMV 4.0
  - 73S801RT device supports 3V / 5V cards up to 65mA and 1.8V up to 40mA
  - ISO 7816-3 Activation / Deactivation sequencer
  - Automated deactivation upon hardware fault (i.e. upon drop on V_{DD} power supply or card overcurrent)
  - The V_{DD} voltage supervisor threshold value (fault) can be externally adjusted
  - Over-current detection 130mA max
  - Card CLK clock frequency up to 20MHz
- **System Controller Interface:**
  - 3 Digital inputs control the card activation / deactivation, card reset and card voltage
  - 2 Digital inputs control the card clock frequency
  - 1 Digital output, interrupt to the system controller, reports to the host the card presence and faults
  - Crystal oscillator or host clock, up to 27MHz
- **Regulator Power Supply:**
  - 4.75V to 5.5V (EMV 4.0)
- **Digital Interfacing: 2.7V to 5.5V**
- **6kV ESD protection on the card interface**
- **Package: SO 20-pin**
- **RoHS compliant (6/6) lead-free package**

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FUNCTIONAL DIAGRAM

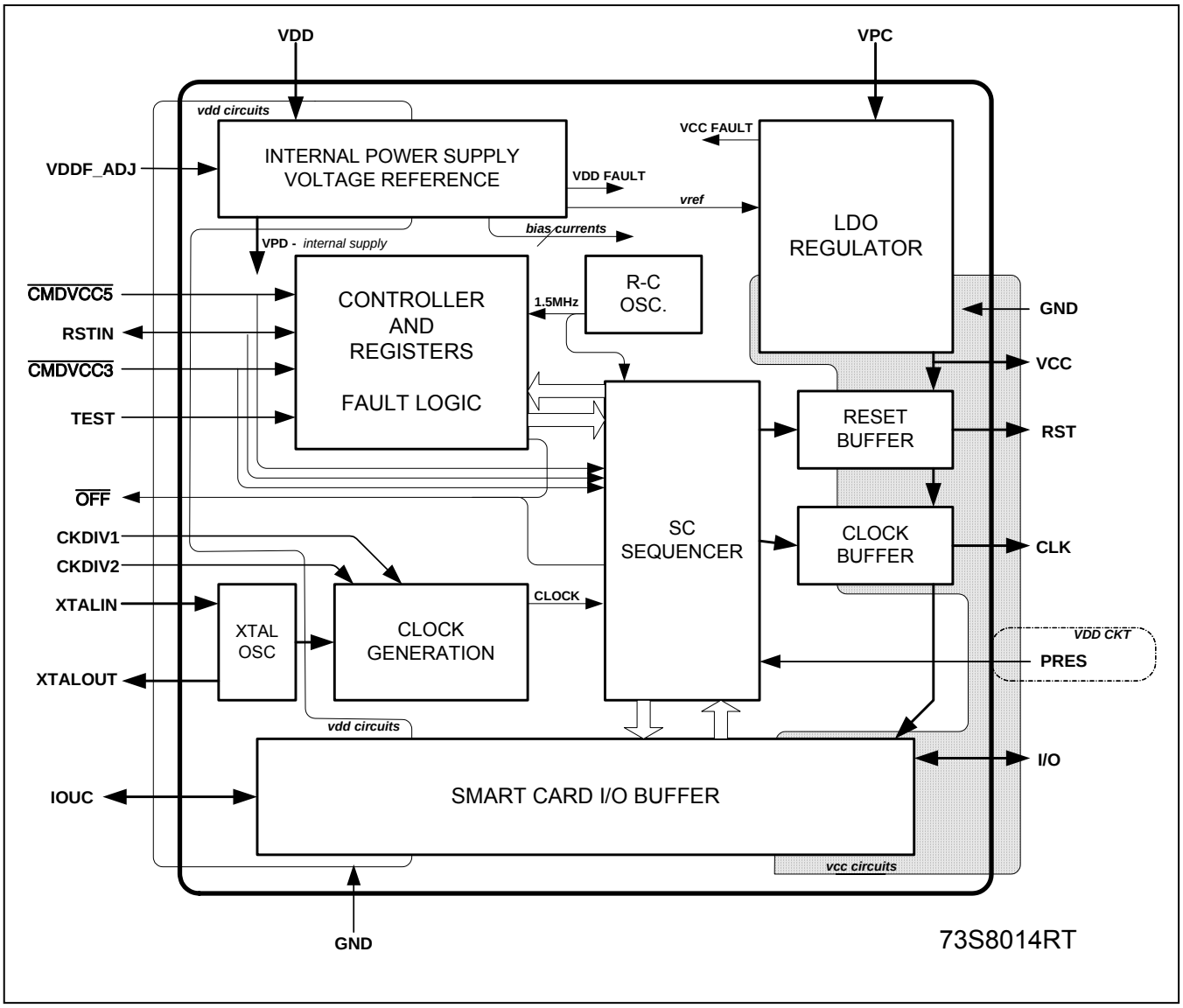


Figure 1: 73S8014RT Block Diagram

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1 Pinout

The 73S8014RT is supplied as a 20-pin SO package.

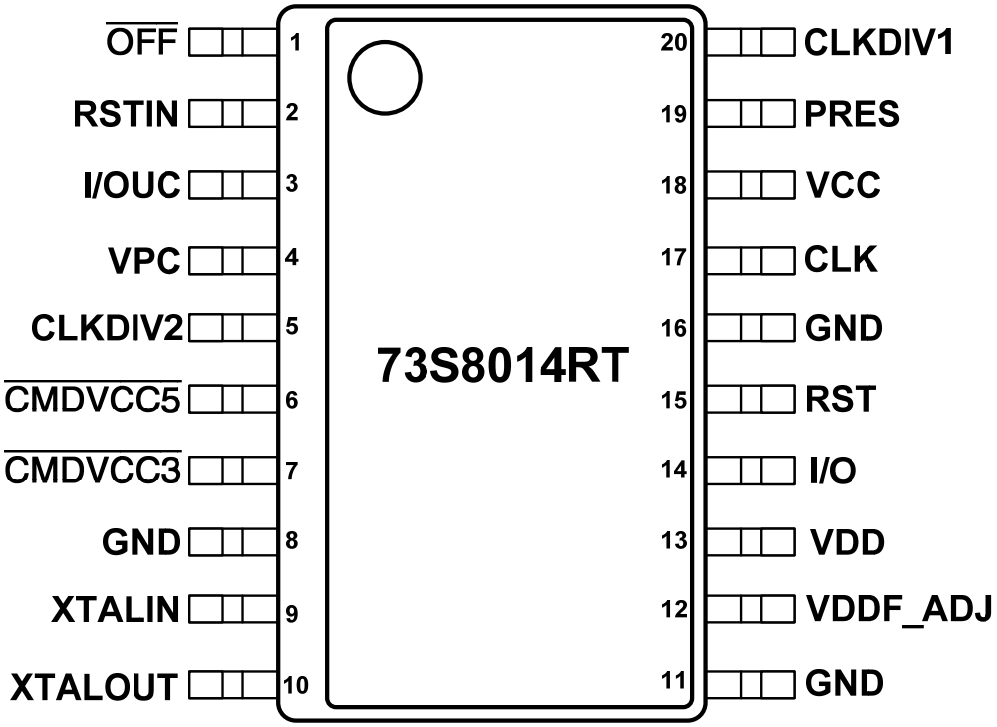


Figure 2: 73S8014RT 20-SOP Pin Out

Table 1 provides the 73S8014RT pin names, pin numbers, type, equivalent circuits and descriptions.

Table 1: 73S8014RT 20-Pin SOP Pin Definitions

Pin Name	Pin Number	Type	Equivalent Circuit	Description
Card Interface				
I/O	14	IO	Figure 14	Card I/O: Data signal to/from card. Includes an 11K pull-up resistor to $V_{CC.}$
RST	15	O	Figure 13	Card reset: provides reset (RST) signal to card.
CLK	17	O	Figure 12	Card clock: provides clock signal (CLK) to card. The rate of this clock is determined by the external crystal frequency or frequency of the external clock signal applied on XTALIN and CLKDIV selections.
PRES	19	I	Figure 16	Card Presence switch: active high indicates card is present. Includes a high-impedance pull-down current source.
VCC	18	PSO	Figure 11	Card power supply – logically controlled by sequencer, output of LDO regulator. Requires an external filter capacitor to the card GND.
GND	16	GND	–	Card ground.
Host Processor Interface				
$\overline{\text{CMDVCC5}}$	6	I	Figure 16	Logic low on one or both of these pins will cause the LDO regulator to ramp the Vcc supply to the smart card and smart card interface to the value described in the following table: $\overline{\text{CMDVCC5}}$ / $\overline{\text{CMDVCC3}}$ / Vcc Output Voltage 0 / 0 / 1.8V 0 / 1 / 5.0V 1 / 0 / 3.0V 1 / 1 / Vcc Off Note: See Section 3.2 for more details.
$\overline{\text{CMDVCC3}}$	7	I	Figure 16	
CLKDIV1 CLKDIV2	20 5	I	Figure 16	Sets the divide ratio from the XTAL oscillator (or external clock input) to the card clock. These pins include a pull-up resistor for CLKDIV1 and CLKLDIV2 to provide a default rate of divide by two. CLKDIV1 / CLKDIV2 / CLOCK RATE 0 / 0 / XTALIN/6 0 / 1 / XTALIN/4 1 / 1 / XTALIN/2 1 / 0 / XTALIN
$\overline{\text{OFF}}$	1	O	Figure 10	Interrupt signal to the processor. Active Low – Multi-function indicating fault conditions and card presence. Open drain output configuration. It includes an internal 20kΩ pull-up to $V_{DD.}$
RSTIN	2	I	Figure 16	Reset Input: This signal is the reset command to the card.
I/OUC	3	IO	Figure 15	System controller data I/O to/from the card. Includes an 11K pull-up resistor to $V_{DD.}$

Miscellaneous Inputs and Outputs				
XTALIN	9		Figure 17	Crystal oscillator input: can either be connected to crystal or driven as a source for the card clock.
XTALOUT	10		Figure 17	Crystal oscillator output: connected to crystal. Left open if XTALIN is being used as external clock input.
VDDF_ADJ	12		Figure 18	V_{DD} fault threshold adjustment input: this pin can be used to adjust the V_{DDF} value (that controls deactivation of the card). Must be left open if unused.
Power Supply and Ground				
VDD	13	PSO	Figure 11	System interface supply voltage and supply voltage for internal circuitry.
VPC	4	PSO	Figure 11	LDO regulator power supply source.
GND	8, 11	GND	–	Digital ground.

2 Electrical Specifications

This section provides the following:

- Absolute maximum ratings
- Recommended operating conditions
- Package thermal parameters
- Smart card interface requirements
- Digital signals characteristics
- DC Characteristics
- Voltage Fault Detection Circuits

2.1 Absolute Maximum Ratings

Table 2 lists the maximum operating conditions for the 73S8014RT. Permanent device damage may occur if absolute maximum ratings are exceeded. Exposure to the extremes of the absolute maximum rating for extended periods may affect device reliability. The smart card interface pins are protected against short circuits to V_{CC}, ground, and each other.

Table 2: Absolute Maximum Device Ratings

Parameter	Rating
Supply Voltage V_{DD}	-0.5 to 6.0 VDC
Supply Voltage V_{PC}	-0.5 to 6.0 VDC
Input Voltage for Digital Inputs	-0.3 to (V_{DD} +0.5) VDC
Storage Temperature	-60 to 150°C
Pin Voltage (except card interface)	-0.3 to (V_{DD} +0.5) VDC
Pin Voltage (card interface)	-0.3 to (V_{CC} + 0.5) VDC
ESD Tolerance – Card interface pins	+/- 6kV
ESD Tolerance – Other pins	+/- 2kV

* Note: ESD testing on smart card pins is HBM condition, 3 pulses, each polarity referenced to ground.
Note: Smart Card pins are protected against shorts between any combinations of Smart Card pins.

2.2 Recommended Operating Conditions

Function operation should be restricted to the recommended operating conditions specified in Table 3.

Table 3: Recommended Operating Conditions

Parameter	Rating
Supply Voltage V_{DD}	2.7 to 5.5 VDC
Supply Voltage V_{PC}	4.75 to 5.5 VDC
Ambient Operating Temperature	-40°C to +85°C
Input Voltage for Digital Inputs	0V to V_{DD} + 0.3V

2.3 Package Thermal Parameters

Table 4 lists the 73S8014RT Smart Card package thermal parameters.

Table 4: Package Thermal Parameters

Parameter	Rating
20 SO	50°C / W

2.4 Smart Card Interface Requirements

Table 5 lists the 73S8014RT Smart Card interface requirements.

Table 5: DC Smart Card Interface Requirements

Symbol	Parameter	Condition	Min	Nom	Max	Unit
Card Power Supply (V_{CC}) Regulator ***General conditions, -40°C < T < 85°C, 4.75V < V_{PC} < 5.5V, 2.7V < V_{DD} < 5.5V***						
V_{CC}	Card supply voltage including ripple and noise	Inactive mode	-0.1		0.1	V
		Inactive mode, I_{CC} = 1mA	-0.1		0.4	V
		Active mode; I_{CC} <65mA; 5V	4.65		5.25	V
		Active mode; I_{CC} <65mA; 3V	2.85		3.15	V
		Active mode; I_{CC} <40mA; 1.8V	1.68		1.92	V
		Active mode; single pulse of 100mA for 2μs; 5V, fixed load = 25mA	4.6		5.25	V
		Active mode; single pulse of 100mA for 2μs; 3V, fixed load = 25mA	2.76		3.2	V
		Active mode; current pulses of 40nAs with peak $\|I_{CC}\|$ <200mA, t <400ns; 5V	4.6		5.25	V
		Active mode; current pulses of 40nAs with peak $\|I_{CC}\|$ <200mA, t <400ns; 3V	2.76		3.15	V
		Active mode; current pulses of 20nAs with peak $\|I_{CC}\|$ <100mA, t <400ns; 1.8V (1)	1.62		1.92	V
V_{CCrip}	V_{CC} Ripple	f_{RIPPLE} = 20K – 200MHz			350	mV
I_{CCmax}	Card supply output current	Static load current, V_{CC}>4.6 or 2.7 volts as selected	65			mA
		Static load current, V_{CC}>1.62	40			mA
I_{CCF}	I_{CC} fault current		70		130	mA
V_{SR}	V_{CC} slew rate, rise	C_F = 1.0μF on V_{CC}	0.06	0.150	0.30	V/μs
V_{SF}	V_{CC} slew rate, fall	C_F = 1.0μF on V_{CC}	0.075	0.150	0.60	V/μs
C_F	External filter cap (V_{CC} to GND)	C_F should be ceramic with low ESR (<100mΩ).	0.5	1.0	1.5	μF

Symbol	Parameter	Condition	Min	Nom	Max	Unit
Interface Requirements – Data Signals: I/O and Host Interfaces: I/OUC. I_{SHORTL}, I_{SHORTH}, and V_{INACT} requirements do not pertain to I/OUC.						
V_{OH}	Output level, high (I/OUC)	I_{OH} =0	0.9 V_{DD}		V_{DD}+0.1	V
		I_{OH} = -40µA	0.75 V_{DD}		V_{DD}+0.1	V
	Output level, high (I/O)	I_{OH} =0	0.9 V_{CC}		V_{CC}+0.1	V
		I_{OH} = -40µA (V_{CC} = 3/5V), I_{OH} = -20µA (V_{CC} = 1.8V)	0.75 V_{CC}		V_{CC}+0.1	V
V_{OL}	Output level, low (I/OUC)	I_{OL}=1mA			0.3	V
	Output level, low (I/O)	Vcc = 5V			0.45	V
		Vcc = 3V			0.2	V
		Vcc = 1.8V			0.15 V_{CC}	V
V_{IH}	Input level, high		1.8		V_{DD} + 0.3	V
	Input level, high (I/O)		0.6 V_{CC}		V_{CC}+0.30	V
V_{IL}	Input level, low		-0.3		0.8	V
	Input level, low (I/O)	Vcc = 5V, 3V	-0.3		0.8	V
		Vcc = 1.8V	-0.3		0.2 V_{CC}	V
V_{INACT}	Output voltage when outside of session	I_{OL} = 0			0.1	V
		I_{OL} = 1mA			0.3	V
I_{LEAK}	Input leakage	V_{IH} = V_{CC}			10	µA
I_{IL}	Input current, low	V_{IL} = 0			0.65	mA
I_{SHORTL}	Short circuit output current	For output low, shorted to V_{CC} through 33 Ω			15	mA
I_{SHORTH}	Short circuit output current	For output high, shorted to ground through 33 Ω			15	mA
t_R, t_F	Output rise time, fall times	C_L = 80pF, 10% to 90%.			100	ns
t_{IR}, t_{IF}	Input rise, fall times				1	µs
R_{PU}	Internal pull-up resistor	Output stable for >400ns	8	11	14	kΩ
FD_{MAX}	Maximum data rate				1	MHz
T_{FDIO}	Delay, I/O to I/OUC, I/OUC to I/O, (respectively falling edge to falling edge and rising edge to rising edge)	Edge from master to slave, measured at 50%	60	100	200	ns
T_{RDIO}				15		ns
C_{IN}	Input capacitance				10	pF

Symbol	Parameter	Condition	Min	Nom	Max	Unit
Reset and Clock for Card Interface, RST, CLK						
V_{OH}	Output level, high	I_{OH} =-200µA	0.9 V_{CC}		V_{CC}	V
V_{OL}	Output level, low	I_{OL}=200µA, V_{CC} = 5V	0		0.45	V
		I_{OL}=200µA, V_{CC} = 3V	0		0.2	V
		I_{OL}=200µA, V_{CC} = 1.8V	0		0.15 V_{CC}	V
V_{INACT}	Output voltage when outside of session	I_{OL} = 0			0.1	V
		I_{OL} = 1mA			0.3	V
I_{RST_LIM}	Output current limit, RST				30	mA
I_{CLK_LIM}	Output current limit, CLK				70	mA
CLK_{SR3V}	CLK slew rate	<	0.3			V/ns
CLK_{SR5V}	CLK slew rate	Vcc = 5V	0.5			V/ns
t_R, t_F	Output rise time, fall time	C_L = 35pF for CLK, 10% to 90%			8	ns
		C_L = 200pF for RST, 10% to 90%			100	ns
δ	Duty cycle for CLK	C_L =35pF, F_{CLK} ≤ 20MHz C_L =35pF, F_{CLK} < 10MHz Vcc = 1.8V	45		55	%

2.5 Characteristics: Digital Signals

Table 6 lists the 73S8014RT digital signals characteristics.

Table 6: Digital Signals Characteristics

Symbol	Parameter	Condition	Min	Nom	Max	Unit
Digital I/O Except for XTALIN and XTALOUT						
V_{IL}	Input Low Voltage		-0.3		0.8	V
V_{IH}	Input High Voltage		1.8		V_{DD} + 0.3	V
V_{OL}	Output Low Voltage	I_{OL} = 2mA			0.45	V
V_{OH}	Output High Voltage	I_{OH} = -1mA	V_{DD} - 0.45			V
R_{OUT}	Pull-up resistor, $\overline{OFF}$		16	20	24	kΩ
$\|I_{IL1}\|$	Input Leakage Current	GND < V_{IN} < V_{DD}	-5		5	µA
$\|I_{IL2}\|$	Input Leakage Current	GND < V_{IN} < V_{DD} CLKDIV2 only	-15		15	µA

Oscillator (XTALIN) I/O Parameters						
V_{ILXTAL}	Input Low Voltage - XTALIN		-0.3		0.3 V_{DD}	V
V_{IHXTAL}	Input High Voltage - XTALIN		0.7 V_{DD}		V_{DD}+0.3	V
I_{ILXTAL}	Input Current - XTALIN	GND < V_{IN} < V_{DD}	-30		30	µA
f_{MAX}	Max freq. Osc or external clock				27	MHz
δin	External input duty cycle limit	tR/F < 10% fIN, 45% < δ_{CLK} < 55%	48		52	%

2.6 DC Characteristics

Table 7 lists the 73S8014RT DC characteristics.

Table 7: DC Characteristics

Symbol	Parameter	Condition	Min	Nom	Max	Unit
I_{DD}	Supply Current	12 MHz XTAL		2.7	7.0	mA
		Ext CLK, V_{DD} = 2.7 – 3.6V, V_{CC} Off		1.7		mA
		Ext CLK, V_{DD} = 2.7 – 3.6V, V_{CC} On		2.2		mA
		Ext CLK, V_{DD} = 4.5 – 5.5V, V_{CC} Off		2.7		mA
		Ext CLK, V_{DD} = 4.5 – 5.5V, V_{CC} On		3		mA
I_{PC}	Supply Current	V_{CC} on, ICC=0 I/O, AUX1, AUX2=high, Clock not toggling		450	700	µA
I_{PCOFF}	V_{PC} supply current when V_{CC} = 0	$\overline{CMDVCC5}$ or $\overline{CMDVCC3}$ High		345	650	µA

2.7 Voltage Fault Detection Circuits

Table 8 lists the 73S8014RT Voltage Fault Detection Circuits.

Table 8: Voltage Fault Detection Circuits

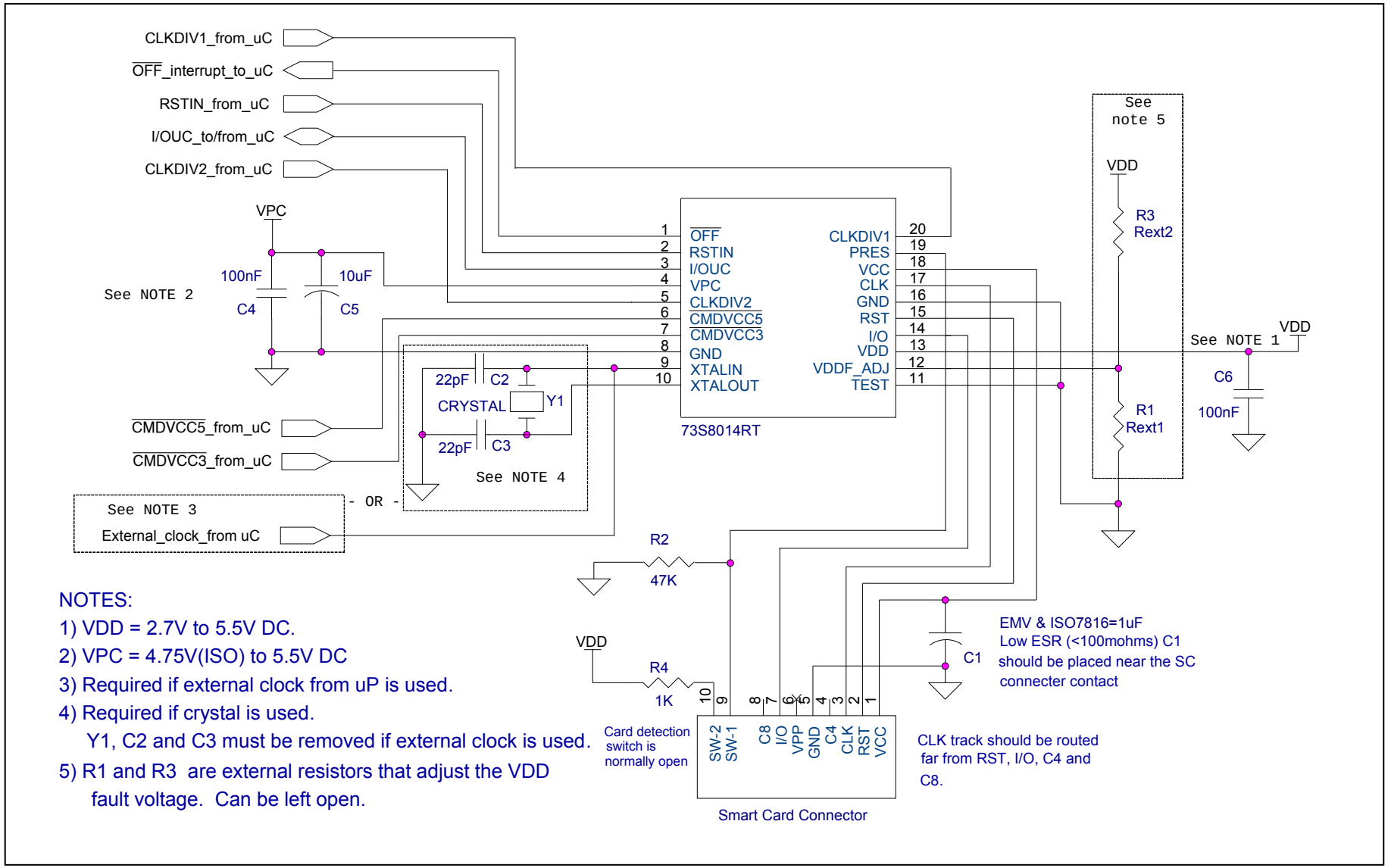
Symbol	Parameter	Condition	Min	Nom	Max	Unit
V_{DDF}	V_{DD} fault (V_{DD} Voltage supervisor threshold)	No external resistor on VDDF_ADJ pin	2.15		2.4	V
V_{CCF}	V_{CC} fault (V_{CC} Voltage supervisor threshold)	V_{CC} = 5v			4.6	V
		V_{CC}= 3v			2.7	V

3 Applications Information

This section provides general usage information for the design and implementation of the 73S8014RT. The documents listed in Related Documentation provide more detailed information.

3.1 Example 73S8014RT Schematics

Figure 3 shows a typical application schematic for the implementation of the 73S8014RT.



NOTES:

1) VDD = 2.7V to 5.5V DC.
2) VPC = 4.75V(ISO) to 5.5V DC
3) Required if external clock from uP is used.
4) Required if crystal is used.
   Y1, C2 and C3 must be removed if external clock is used.
5) R1 and R3 are external resistors that adjust the VDD fault voltage. Can be left open.

Figure 3: 73S8014RT – Typical Application Schematic

3.2 System Controller Interface

Three digital inputs allow direct control of the card interface by the host.

The 73S8014RT is controlled as follows:

- Pins $\overline{\text{CMDVCC5}}$ and/or $\overline{\text{CMDVCC3}}$: When low, starts an activation sequence at the voltage specified in Table 9.
- Pin RSTIN: controls the card RST signal (when enabled by the sequencer)

Table 9: V_{CC} Voltage Logic Table

Control Pins		V_{CC} Voltage	Notes
$\overline{\text{CMDVCC5}}$	$\overline{\text{CMDVCC3}}$		
1	1	0V	Off
0	1	5V	
1	0	3V	
0	0	1.8V	Must be asserted within 400ns of each other to generate 1.8V

Card clock frequency can be controlled by 2 digital inputs:

- CLKDIV1 and CLKDIV2 define the division rate for the clock frequency, from the input clock frequency (crystal or external clock)

Interrupt output to the host: As long as the card is not activated, the $\overline{\text{OFF}}$ pin informs the host about the card presence only (Low = No card in the reader). When $\overline{\text{CMDVCC5}}$ or $\overline{\text{CMDVCC3}}$ is asserted low (Card activation sequence requested from the host), low level on $\overline{\text{OFF}}$ means a fault has been detected (e.g. card removal during card session, voltage fault, or over-current fault) that automatically initiates a deactivation sequence.

3.3 Power Supply and Voltage Supervision

The Teridian 73S8014RT smart card interface ICs incorporate an LDO voltage regulator. The voltage output is controlled by both the $\overline{\text{CMDVCC5}}$ and $\overline{\text{CMDVCC3}}$ pins. This regulator is able to provide either 3V or 5V or 1.8V card voltage from the power supply applied on the VPC pin. The voltage regulator can provide a current of at least 65mA on VCC for both 3V and 5V that complies with EMV 4.0.

Digital circuitry is powered by the power supply applied on the VDD pin. V_{DD} also defines the voltage range to interface with the system controller. A card deactivation sequence is forced upon fault of any of this voltage supervisor. One voltage supervisor constantly monitors the V_{DD} voltage. It is used to initialize the ISO-7816-3 sequencer at power-on, and to deactivate the card at power-off or upon fault. The voltage threshold of the V_{DD} voltage supervisor is internally set by default to 2.26V nominal. However, it may be desirable, in some applications, to modify this threshold value.

The method of adjusting the V_{DD} fault voltage is to use a resistive network of R3 from the VDDF_ADJ pin to V_{DD} supply and R1 from the VDDF_ADJ pin to ground (see application schematics). In order to set the new threshold voltage, the equivalent voltage divider ratio must be determined. This ratio value will be designated Kx. Kx is defined as R1/(R1+R3). Kx is calculated as:

$Kx = (2.71 / V_{TH}) - 0.595$ where V_{TH} is the desired new threshold voltage.

To determine the values of R1 and R3, use the following formulas (the parallel resistance of R1 and R3 is selected to be 24000 ohms)

$R3 = 24000 / Kx$ $R1 = R3*(Kx / (1 – Kx))$

Taking the example above, where a V_{DD} fault threshold voltage of 2.6V is desired, solving for Kx gives:
→ Kx = (2.71 / 2.6) - 0.595 = 0.4473.
Solving for R3 gives: → R3 = 24000 / 0.4473 = 53654.
Solving for R1 gives: → R1 = 58752 *(0.4473 / (1 – 0.4473)) = 43422.
Using standard 1 % resistor values gives R3 = 53.6KΩ and R1 = 43.2KΩ.

Using 1% external resistors and a parallel resistance of 24K ohms will result in a +/- 6% tolerance in the value of VDD Fault. The sources of variation due to integrated circuit process variations and mismatches include the internal reference voltage (less than +/- 1%), the internal comparator hysteresis and offset (less than +/- 1.7% for part-to-part, processing and environment), the internal resistor value mismatch and value variations (less than 1.8%), and the external resistor values (1%).

If the 2.26V default threshold is used, this pin must be left unconnected.

3.4 Card Power Supply

The card power supply is internally provided by the LDO regulator and controlled by the digital ISO-7816-3 sequencer. Card voltage selection on the 73S8014RT is carried out by the digital inputs $\overline{\text{CMDVCC5}}$ and $\overline{\text{CMDVCC3}}$.

3.5 On-Chip Oscillator and Card Clock

The 73S8014RT devices have an on-chip oscillator that can generate the smart card clock using an external crystal (connected between the pins XTALIN and XTALOUT) to set the oscillator frequency. When the clock signal is available from another source, it can be connected to the pin XTALIN, and the pin XTALOUT should be left unconnected.

The card clock frequency may be chosen between 4 different division rates, defined by digital inputs CLKDIV 1 and CLKDIV 2, as per the following table:

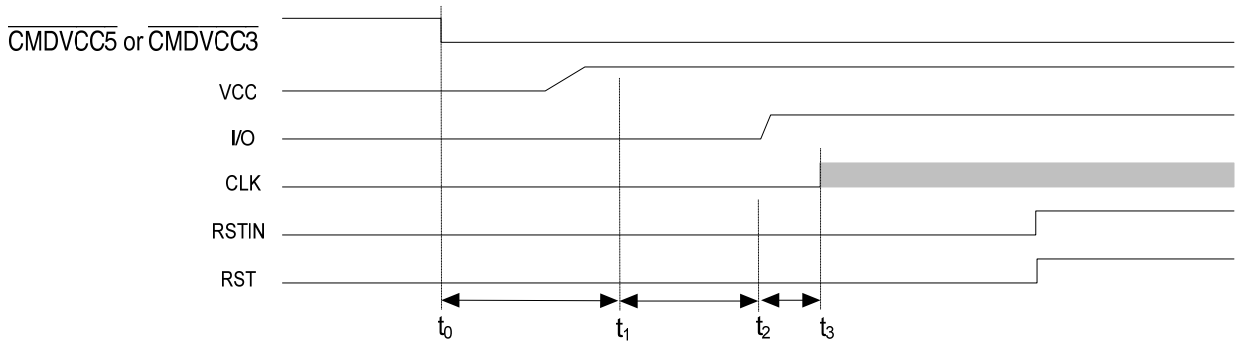
CLKDIV1	CLKDIV2	CLK	Max XTALIN
0	0	1/6 XTALIN	27MHz
0	1	¼ XTALIN	27MHz
1	0	XTALIN	20MHz
1	1	½ XTALIN	27MHz

3.6 Activation Sequence

The 73S8014RT smart card interface ICs have an internal 10ms delay on the application of V_{DD} where $V_{DD} > V_{DDF}$. No activation is allowed during this 10ms period. The CMDVCC% or CMDVCC# (edge triggered) signals must then be set low to activate the card. In order to initiate activation, the card must be present; there can be no V_{DD} fault.

The following steps show the activation sequence and the timing of the card control signals when the system controller sets CMDVCC% or CMDVCC# low while the RSTIN is low:

- CMDVCC% or CMDVCC# is set low at t_0.
- V_{CC} will rise to the selected level and then the internal V_{CC} control circuit checks the presence of V_{CC} at the end of t_1. In normal operation, the voltage V_{CC} to the card becomes valid before t_1. If V_{CC} is not valid at t_1, the OFF goes low to report a fault to the system controller, and V_{CC} to the card is shut off.
- Turn I/O to reception mode at t_2.
- CLK is applied to the card at t_3.
- RST is a copy of RSTIN after t_3.

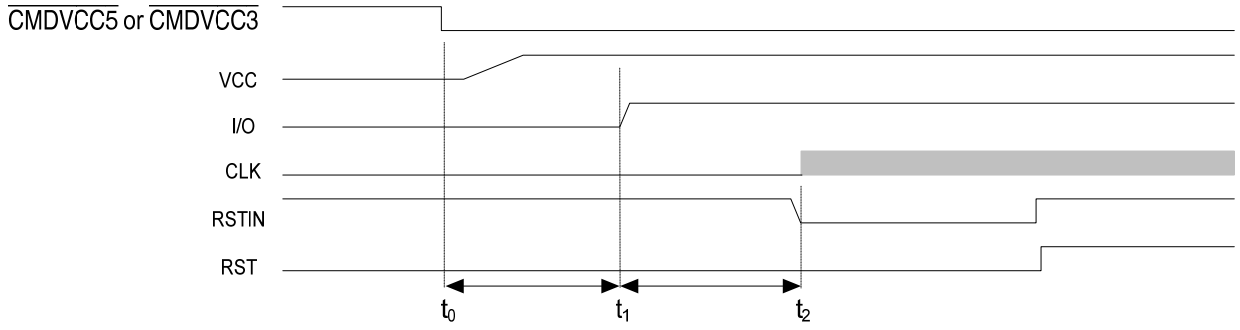


t_1 = 0.510 ms (timing by 1.5MHz internal oscillator)
t_2 = 1.5µs, I/O goes to reception state
t_3 = >0.5µs, CLK starts, RST to become the copy of RSTIN

Figure 4: Activation Sequence – RSTIN Low When $\overline{\text{CMDVCC5}}$ or $\overline{\text{CMDVCC3}}$ Goes Low

The following steps show the activation sequence and the timing of the card control signals when the system controller pulls CMDVCC% or CMDVCC# low while the RSTIN is high:

- CMDVCC% or CMDVCC# is set low at t_0.
- VCC will rise to the selected level and then the internal V_{CC} control circuit checks the presence of VCC at the end of t_1. In normal operation, the voltage V_{CC} to the card becomes valid before t_1. If VCC is not valid at t_1, the OFF goes low to report a fault to the system controller, and V_{CC} to the card is shut off.
- At the fall of RSTIN at t_2, CLK is applied to the card
- RST is a copy of RSTIN after t_2.



t_1 = 0.510 ms (timing by 1.5MHz internal oscillator, I/O goes to reception state)
t_2 = RSTIN goes low and CLK becomes active
t_3 = > 0.5µs, CLK active, RST to become the copy of RSTIN

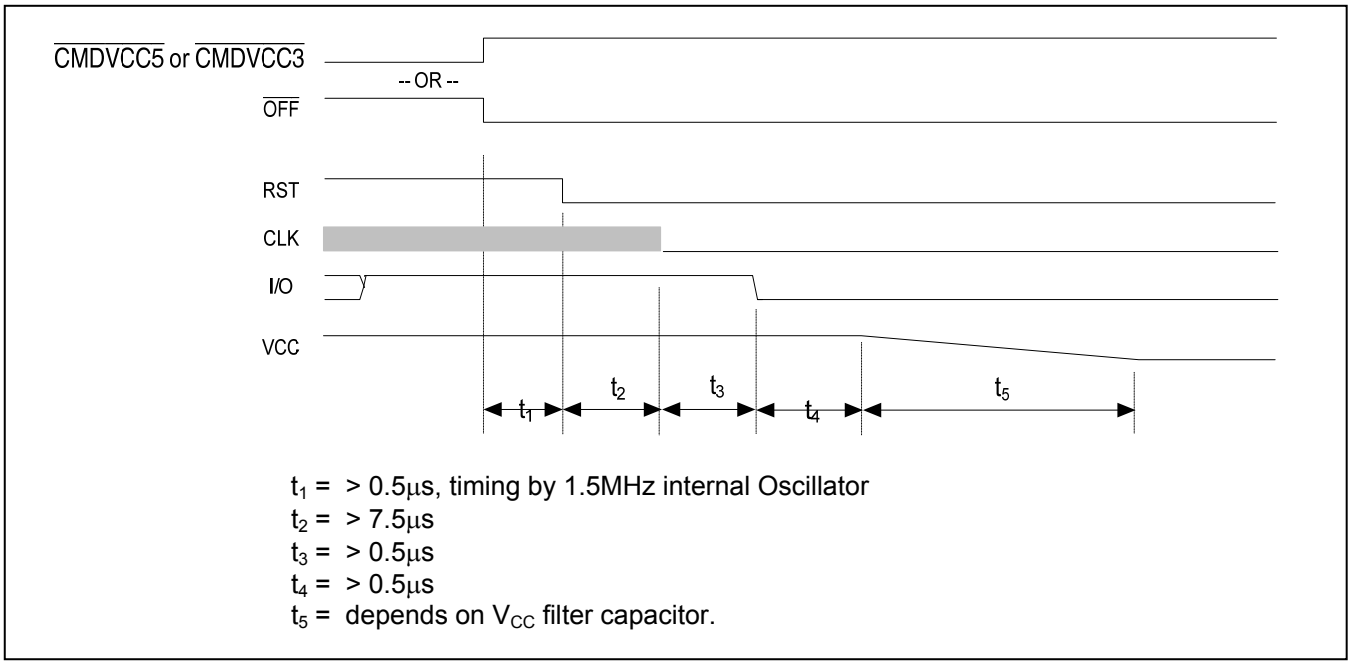
Figure 5: Activation Sequence – RSTIN High When $\overline{\text{CMDVCC5}}$ or $\overline{\text{CMDVCC3}}$ Goes Low

3.7 Deactivation Sequence

Deactivation is initiated either by the system controller by setting CMDVCC% and CMDVCC# high, or automatically in the event of hardware faults. Hardware faults are over-current, V_{DD} fault, V_{CC} fault, and card extraction during the session.

The following steps show the deactivation sequence and the timing of the card control signals when the system controller sets CMDVCC% and CMDVCC# high or OFF goes low due to a fault or card removal:

- RST goes low at the end of t_1.
- CLK is set low at the end of t_2.
- I/O goes low at the end of t_3. Out of reception mode.
- V_{CC} is shut down at the end of time t_4. After a delay t_5 (discharge of the V_{CC} capacitor), V_{CC} is low.



t_1 = > 0.5µs, timing by 1.5MHz internal Oscillator
t_2 = > 7.5µs
t_3 = > 0.5µs
t_4 = > 0.5µs
t_5 = depends on V_{CC} filter capacitor.

Figure 6: Deactivation Sequence

3.8 Fault Detection and $\overline{OFF}$

There are two different cases that the system controller can monitor the $\overline{OFF}$ signal: to query regarding the card presence outside card sessions, or for fault detection during card sessions.

Outside a card session: In this condition, $\overline{CMDVCC5}$ and $\overline{CMDVCC3}$ are always high, $\overline{OFF}$ is low if the card is not present, and high if the card is present. Because it is outside a card session, any fault detection will not act upon the $\overline{OFF}$ signal. No deactivation is required during this time.

During a card session: $\overline{CMDVCC5}$ or $\overline{CMDVCC3}$ is/are always low, and $\overline{OFF}$ falls low if the card is extracted or if any fault detection is detected. At the same time that $\overline{OFF}$ is set low, the sequencer starts the deactivation process.

Figure 7 shows the timing diagram for the signals $\overline{CMDVCC5}$ or $\overline{CMDVCC3}$, PRES, and $\overline{OFF}$ during a card session and outside the card session:

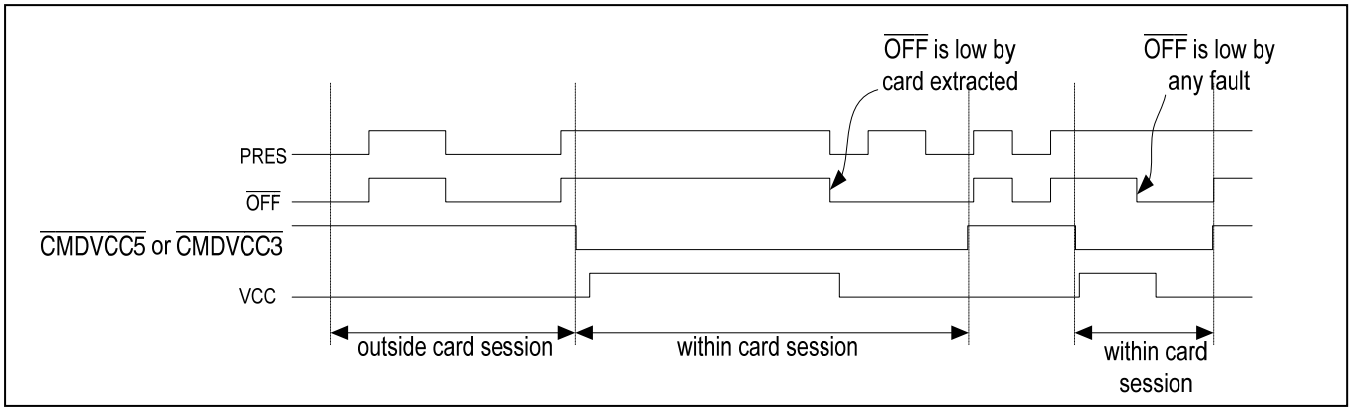


Figure 7: Timing Diagram – Management of the Interrupt Line $\overline{OFF}$

3.9 I/O Circuitry and Timing

The state of the I/O pin is low after power on reset and it goes high when the activation sequencer turns on the I/O reception state. See the Activation Sequence section for details on when the I/O reception is enabled. The state of I/OUC is high after power on reset.

Within a card session and when the I/O reception state is turned on, the first I/O line on which a falling edge is detected becomes the input I/O line and the other becomes the output I/O line. When the input I/O line rising edge is detected then both I/O lines return to their neutral state.

Figure 8 shows the state diagram of how the I/O and I/OUC lines are managed to become input or output. The delay between the I/O signals is shown in Figure 9.

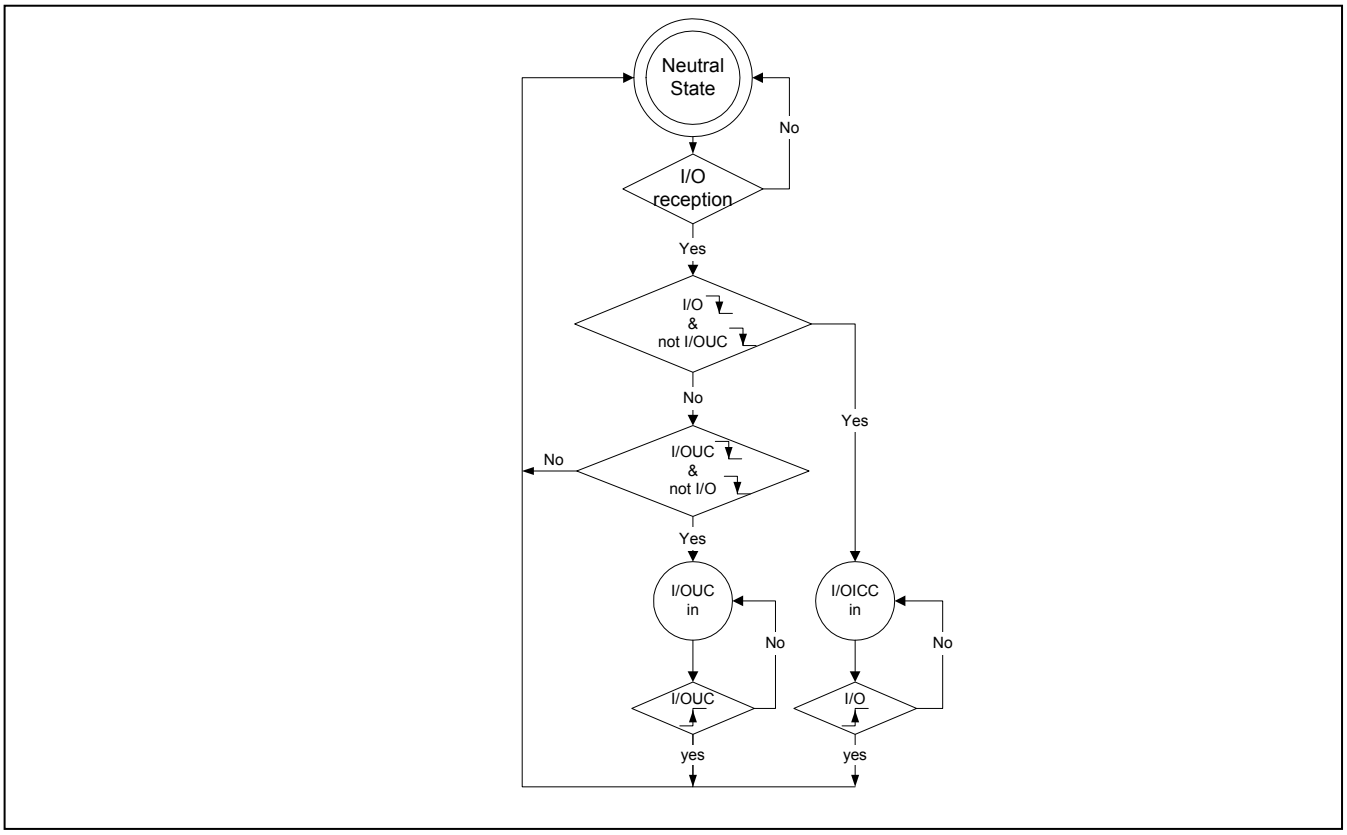


Figure 8: I/O and I/OUC State Diagram

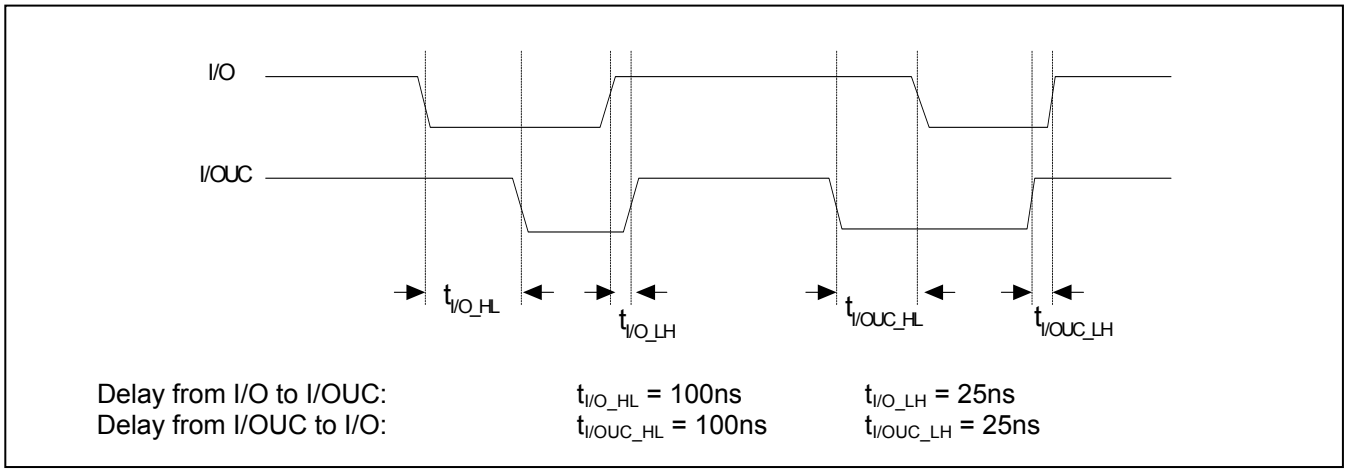


Figure 9: I/O – I/OUC Delays – Timing Diagram

4 Equivalent Circuits

This section provides illustrations of circuits equivalent to those described in the pinout section.

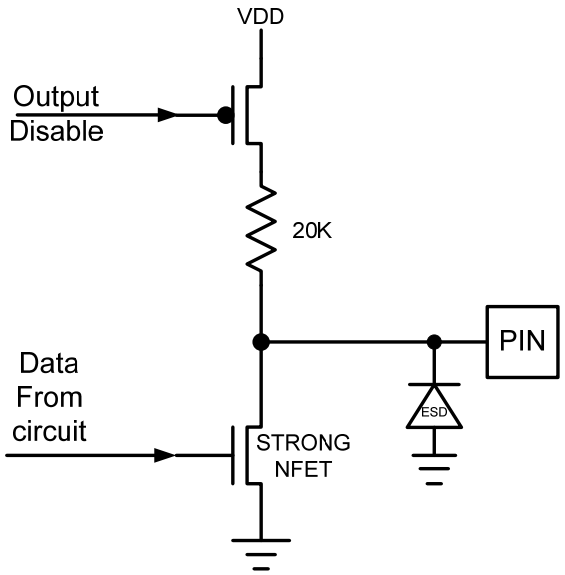


Figure 10: Open Drain type – $\overline{\text{OFF}}$

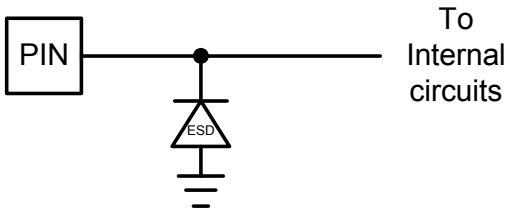


Figure 11: Power Input/Output Circuit, V_{DD}, V_{PC}, V_{CC}

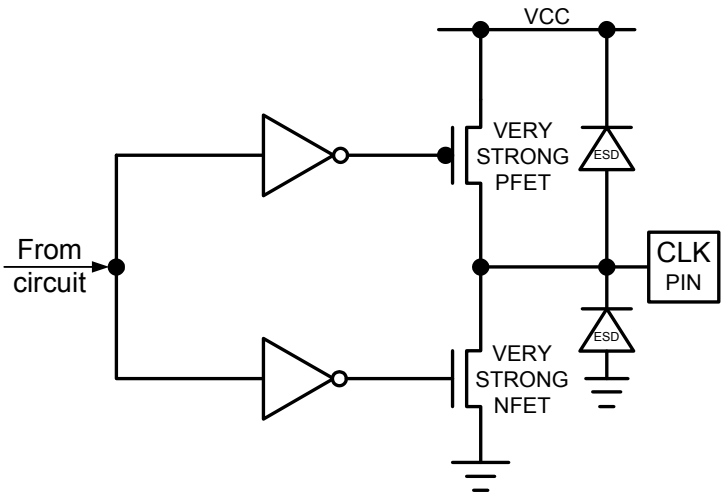


Figure 12: Type 5 – Smart Card CLK Driver Circuit

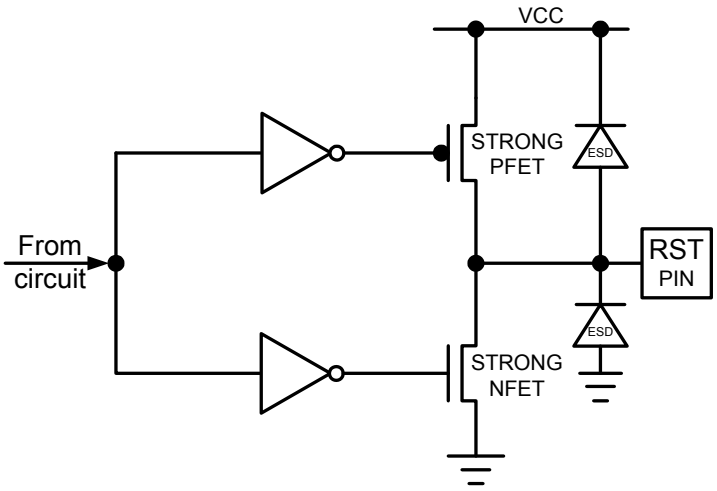


Figure 13: Type 6 – Smart Card RST Driver Circuit

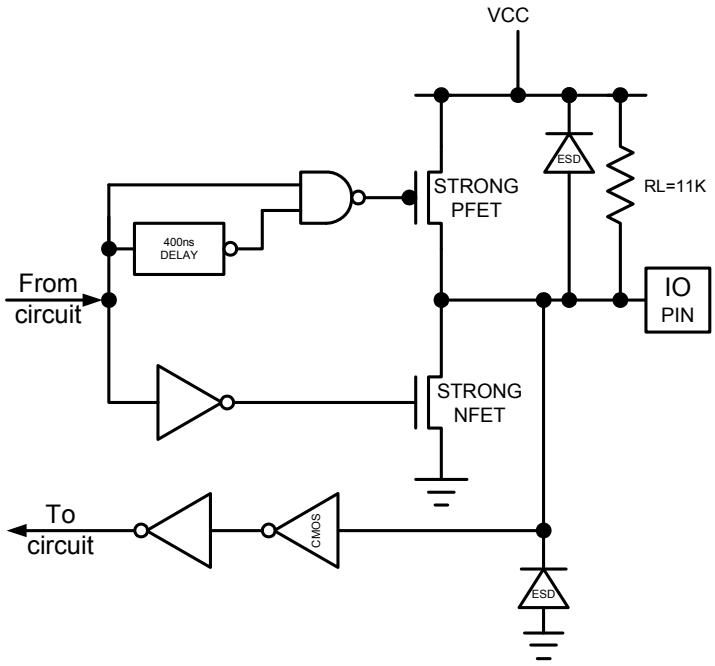


Figure 14: Type 7A – Smart Card IO Interface Circuit

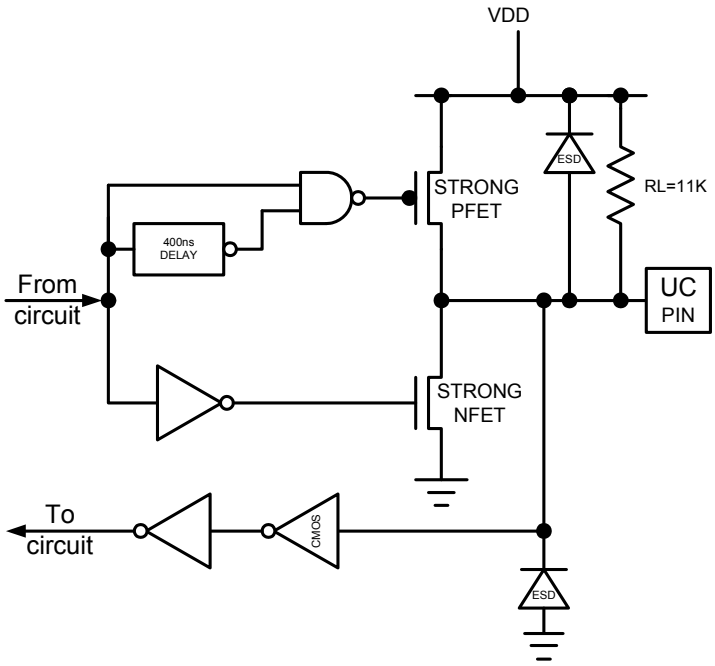
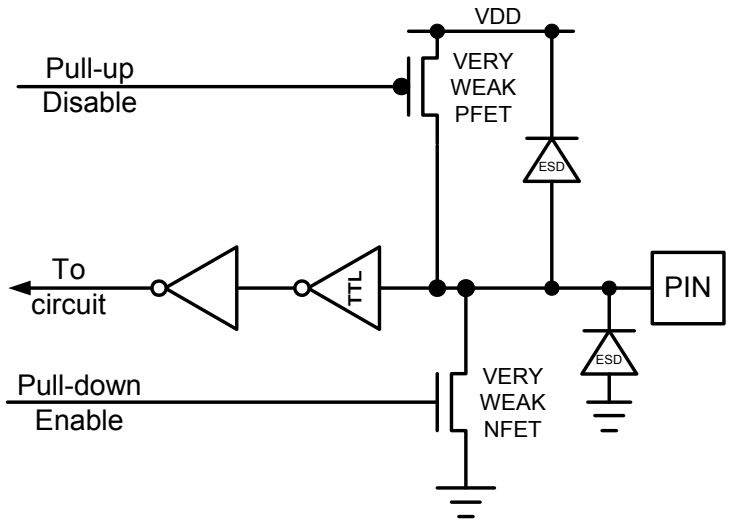


Figure 15: Type 7B – Smart Card IOUC Interface Circuit



Note: Pins $\overline{\text{CMDVCC5}}$, $\overline{\text{CMDVCC3}}$, CLKDIV1 and CLKDIV2 have the pull-up enabled.
Pins RSTIN, CLKIN, PRES have the pull-down enabled.

Figure 16: Type 8 – General Input Circuit

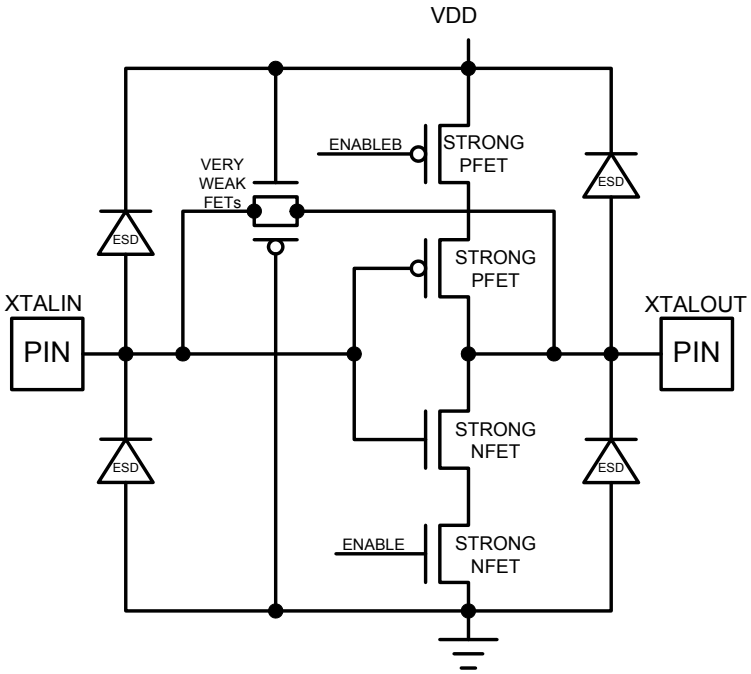


Figure 17: Oscillator Circuit

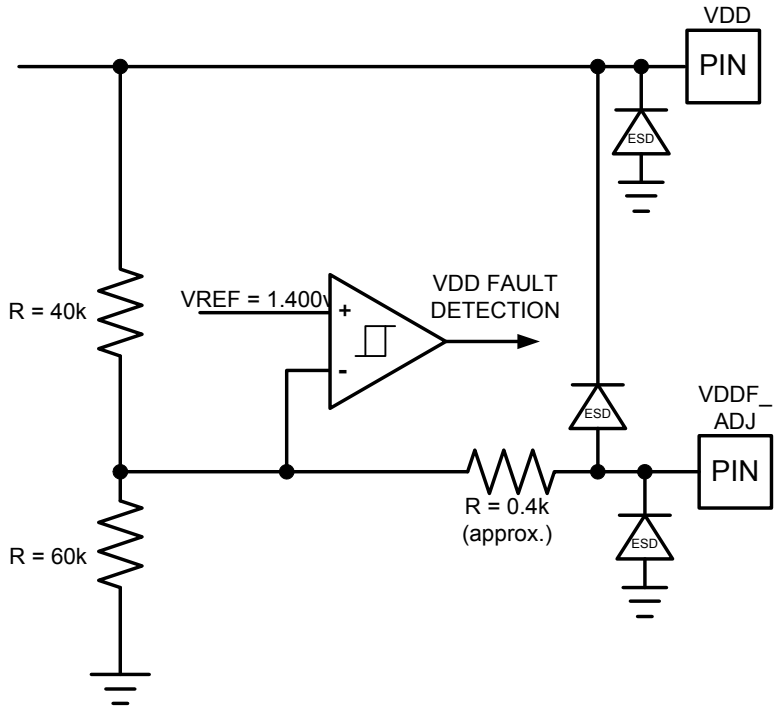


Figure 18: VDD_{FLT_ADJ}

5 Mechanical Drawing

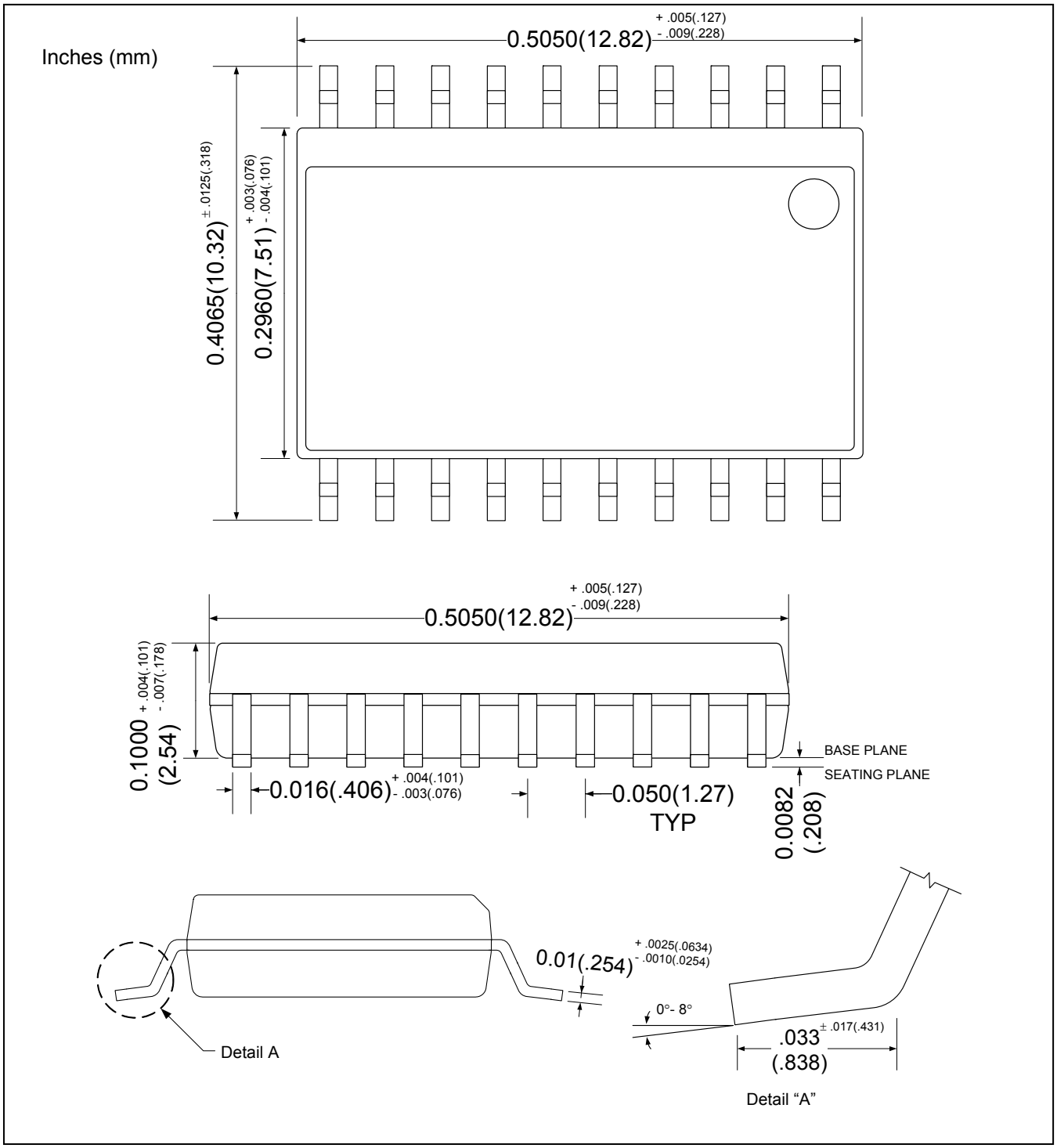


Figure 19: Mechanical Drawing 20-Pin SO Package

6 Ordering Information

Table 10 lists the order numbers and packaging marks used to identify 73S8014RT products.

Table 10: Order Numbers and Packaging Marks

Part Description	Order Number	Packaging Mark
73S8014RT 20-pin Lead-Free	73S8014RT-IL/F	73S8014RT
73S8014RT 20-pin Lead-Free Tape / Reel	73S8014RT-ILR/F	73S8014RT

7 Related Documentation

The following 73S8014RT document is available from Teridian Semiconductor Corporation:

73S8014R/RN/RT 20SO Demo Board User Manual

8 Contact Information

For more information about Teridian Semiconductor products or to check the availability of the 73S8014RT, contact us at:

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For a complete list of worldwide sales offices, go to http://www.teridian.com.

Revision History

Revision	Date	Description
1.0	12/12/2008	First publication.

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