



V.34, V.17 FAX ISOMODEM[®] WITH GLOBAL DAA

Features

- Fax modem formats
 - V.29, V.27ter, V.17, V.21 channel 2
 - V.34 half duplex
 - Automatic rate negotiation
- Supports type I and II caller ID
- No external ROM or RAM required
- Distinctive ring detection
- UART or parallel interface
- Lead-free/RoHS-compliant packages available
- Integrated DAA
 - Over 6000 V capacitive isolation
 - Parallel phone detect
 - Globally-compliant line interface
 - Overcurrent detection
- Firmware upgradeable
- DTMF detection/generation
- Data/Fax discriminator
- Class1 AT command set

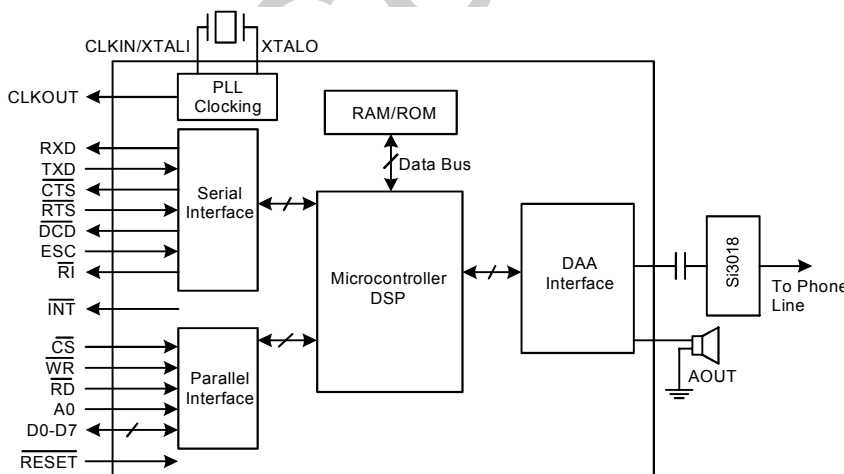
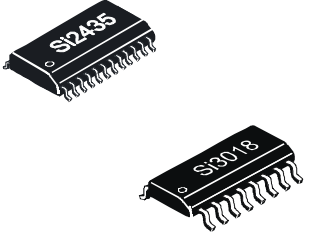
Applications

- Fax machines
- Fax telephones
- Multifunctional printers
- Fax server

Description

The Si2435 and Si2417 are complete two-chip fax modems ranging in speed from 33,600 bps to 14,400 bps. The ISOModem chipsets utilize Silicon Laboratories' third-generation direct access arrangement (DAA) to provide a globally-programmable telephone line interface with an unparalleled level of integration. Available in two small packages, the compact solutions eliminate the need for a separate DSP, modem controller, codec, isolation transformer, relay, opto-isolators, and 2–4 wire hybrid. The ISOModem provides conventional fax formats with connect rates of up to 33,600 bps over the Public Switched Telephone Network (PSTN). The Si2435 and Si2417 are ideal for fax modem applications due to their global compliance, small footprint, and minimal external component count.

Functional Block Diagram

Ordering Information

This data sheet is valid only for those chipset combinations listed on page 61.

Pin Assignments

| Si2435/17 | |
|-------------|----------|
| CLKIN/XTALI | 1 |
| XTALO | 2 |
| CLKOUT/A0 | 3 |
| FSYNC/D6 | 4 |
| VD3.3 | 5 |
| GND | 6 |
| VDA | 7 |
| RTS/D7 | 8 |
| RXD/RD | 9 |
| TXD/WR | 10 |
| CTS/CS | 11 |
| RESET | 12 |
| 24 | SDO/D5 |
| 23 | DCD/D4 |
| 22 | ESC/D3 |
| 21 | VD3.3 |
| 20 | GND |
| 19 | VDB |
| 18 | SDI/D2 |
| 17 | RI/D1 |
| 16 | INT/DO |
| 15 | AOUT/INT |
| 14 | C1A |
| 13 | C2A |

| Si3018 | |
|--------|-------|
| QE | 1 |
| DCT | 2 |
| RX | 3 |
| IB | 4 |
| C1B | 5 |
| C2B | 6 |
| VREG | 7 |
| RNG1 | 8 |
| 16 | DCT2 |
| 15 | IGND |
| 14 | DCT3 |
| 13 | QB |
| 12 | QE2 |
| 11 | SC |
| 10 | VREG2 |
| 9 | RNG2 |

U.S. Patent #5,870,046
 U.S. Patent #6,061,009
 Other patents pending

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Si2435/Si2417

1. Electrical Specifications

Table 1. Recommended Operating Conditions

| Parameter ¹ | Symbol | Test Condition | Min ² | Typ | Max ² | Unit |
|--|--------|----------------|------------------|-----|------------------|------|
| Ambient Temperature | T_A | F-Grade | 0 | 25 | 70 | °C |
| Si2435/17 Supply Voltage, Digital ³ | V_D | | 3.0 | 3.3 | 3.6 | V |

Notes:

- The Si2435/17 specifications are guaranteed when the typical application circuit (including component tolerance) and any Si2435/17 and any Si3018 are used. See "2. Typical Application Schematic" on page 10.
- All minimum and maximum specifications are guaranteed and apply across the recommended operating conditions. Typical values apply at nominal supply voltages and an operating temperature of 25 °C unless otherwise stated.
- The digital supply, V_D , operates from 3.0 to 3.6 V. The Si2435/17 interface supports 5 V logic (CLKIN/XTALI supports 3.3 V logic only).

Table 2. Loop Characteristics

($V_D = 3.0$ to 3.6 V, $T_A = 0$ to 70 °C for F-Grade)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|----------------------------------|----------|--|-----|-----|-----|-----------|
| DC Termination Voltage | V_{TR} | $I_L = 20$ mA, ILIM ¹ = 0 DCV = 00, MINI = 11, DCR = 0 | — | — | 6.0 | V |
| DC Termination Voltage | V_{TR} | $I_L = 120$ mA, ILIM = 0 DCV = 00, MINI = 11, DCR = 0 | 9 | — | — | V |
| DC Termination Voltage | V_{TR} | $I_L = 20$ mA, ILIM = 0 DCV = 11, MINI = 00, DCR = 0 | — | — | 7.5 | V |
| DC Termination Voltage | V_{TR} | $I_L = 120$ mA, ILIM = 0 DCV = 11, MINI = 00, DCR = 0 | 9 | — | — | V |
| DC Termination Voltage | V_{TR} | $I_L = 20$ mA, ILIM = 1 DCV = 11, MINI = 00, DCR = 0 | — | — | 7.5 | V |
| DC Termination Voltage | V_{TR} | $I_L = 60$ mA, ILIM = 1 DCV = 11, MINI = 00, DCR = 0 | 40 | — | — | V |
| DC Termination Voltage | V_{TR} | $I_L = 50$ mA, ILIM = 1 DCV = 11, MINI = 00, DCR = 0 | — | — | 40 | V |
| On-Hook Leakage Current | I_{LK} | $V_{TR} = -48$ V | — | — | 5 | μA |
| Operating Loop Current | I_{LP} | MINI = 00, ILIM = 0 | 10 | — | 120 | mA |
| Operating Loop Current | I_{LP} | MINI = 00, ILIM = 1 | 10 | — | 60 | mA |
| DC Ring Current | | DC current flowing through ring detection circuitry | — | 1.5 | 3 | μA |
| Ring Detect Voltage ² | V_{RD} | RT = 0 | 12 | 15 | 18 | V_{RMS} |
| Ring Detect Voltage ² | V_{RD} | RT = 1 | 18 | 21 | 25 | V_{RMS} |
| Ring Frequency | F_R | | 15 | — | 68 | Hz |
| Ringer Equivalence Number | REN | | — | — | 0.2 | |

Notes:

- ILIM = U67, bit 9; DCV = U67, bits 3:2; MINI = U67, bits 13:12; DCR = U67, bit 7; RT = U67, bit 0.
- The ring signal is guaranteed to not be detected below the minimum. The ring signal is guaranteed to be detected above the maximum.

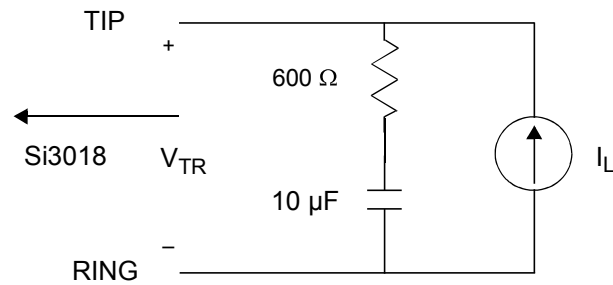


Figure 1. Test Circuit for Loop Characteristics

Table 3. DC Characteristics, $V_D = 3.0$ to 3.6 V $(V_D = 3.0$ to 3.6 V, $T_A = 0$ to 70 °C for F-Grade)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|--|----------|----------------|-----|-----|------|------------|
| High Level Input Voltage | V_{IH} | | 2.0 | — | — | V |
| Low Level Input Voltage | V_{IL} | | — | — | 0.8 | V |
| High Level Output Voltage | V_{OH} | $I_O = -2$ mA | 2.4 | — | — | V |
| Low Level Output Voltage | V_{OL} | $I_O = 2$ mA | — | — | 0.35 | V |
| Input Leakage Current | I_L | | -10 | — | 10 | μ A |
| Pullup Resistance Pins 3, 4, 9, 11, 15, 16, 17, 18, 23, 24 | R_{PU} | | 50 | 125 | 200 | k Ω |
| Total Supply Current* | I_D | $V_{D3.3}$ pin | — | 26 | 35 | mA |
| Total Supply Current, Wake-on-Ring* | I_D | | — | 6 | — | mA |
| Total Supply Current, Powerdown* | I_D | PDN = 1 | — | 80 | — | μ A |

*Note: All inputs at 0 or V_D . All inputs held static except clock and all outputs unloaded (Static $I_{OUT} = 0$ mA).

Si2435/Si2417

Table 4. AC Characteristics

($V_D = 3.0$ to 3.6 V, $T_A = 0$ to 70 °C for F-Grade, $F_s = 8$ kHz)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|------------|--|-----|--------|-----|------------|
| Clock Input Frequency | F_{XTL} | default | — | 4.9152 | — | MHz |
| Clock Input Frequency | F_{XTL} | ≤ 10 k Ω resistor between pin 23 and GND | — | 27 | — | MHz |
| Receive Frequency Response | | Low -3 dBFS Corner, FILT = 0 | — | 5 | — | Hz |
| Receive Frequency Response | | Low -3 dBFS Corner, FILT = 1 | — | 200 | — | Hz |
| Transmit Full Scale Level ¹ | V_{FS} | | — | 1.1 | — | V_{PEAK} |
| Receive Full Scale Level ^{1,2} | V_{FS} | | — | 1.1 | — | V_{PEAK} |
| Dynamic Range ³ | DR | ILIM = 0, DCV = 11, MINI = 00 DCR = 0, $I_L = 100$ mA | — | 80 | — | dB |
| Dynamic Range ³ | DR | ILIM = 0, DCV = 00, MINI = 11 DCR = 0, $I_L = 20$ mA | — | 80 | — | dB |
| Dynamic Range ³ | DR | ILIM = 1, DCV = 11, MINI = 00 DCR = 0, $I_L = 50$ mA | — | 80 | — | dB |
| Transmit Total Harmonic Distortion ⁴ | THD | ILIM = 0, DCV = 11, MINI = 00 DCR = 0, $I_L = 100$ mA | — | -72 | — | dB |
| Transmit Total Harmonic Distortion ⁴ | THD | ILIM = 0, DCV = 00, MINI = 11 DCR = 0, $I_L = 20$ mA | — | -78 | — | dB |
| Receive Total Harmonic Distortion ⁴ | THD | ILIM = 0, DCV = 00, MINI = 11 DCR = 0, $I_L = 20$ mA | — | -78 | — | dB |
| Receive Total Harmonic Distortion ⁴ | THD | ILIM = 1, DCV = 11, MINI = 00 DCR = 0, $I_L = 50$ mA | — | -78 | — | dB |
| Dynamic Range (Caller ID Mode) | DR_{CID} | $V_{IN} = 1$ kHz, -13 dBm | — | 50 | — | dB |

Notes:

1. Measured at TIP and RING with 600 Ω termination at 1 kHz, as shown in Figure 1 on page 5.
2. Receive full scale level produces -0.9 dBFS at DTX.
3. $DR = 20 \times \log |V_{in}| + 20 \times \log (\text{rms signal/rms noise})$. Applies to both transmit and receive paths. $V_{in} = 1$ kHz, -3 dBFS.
4. $V_{in} = 1$ kHz, -3 dBFS. $THD = 20 \times \log (\text{rms distortion/rms signal})$.

Table 5. Absolute Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|------------|-------------------------|------|
| DC Supply Voltage | V_D | 4.1 | V |
| Input Current, Si2435/17 Digital Input Pins | I_{IN} | ± 10 | mA |
| Digital Input Voltage | V_{IND} | -0.3 to 5.3 | V |
| CLKIN/XTALI Input Voltage | V_{XIND} | -0.3 to ($V_D + 0.3$) | V |
| Operating Temperature Range | T_A | -10 to 100 | °C |
| Storage Temperature Range | T_{STG} | -40 to 150 | °C |

Note: Permanent device damage may occur if the above absolute maximum ratings are exceeded. Functional operation should be restricted to the conditions as specified in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

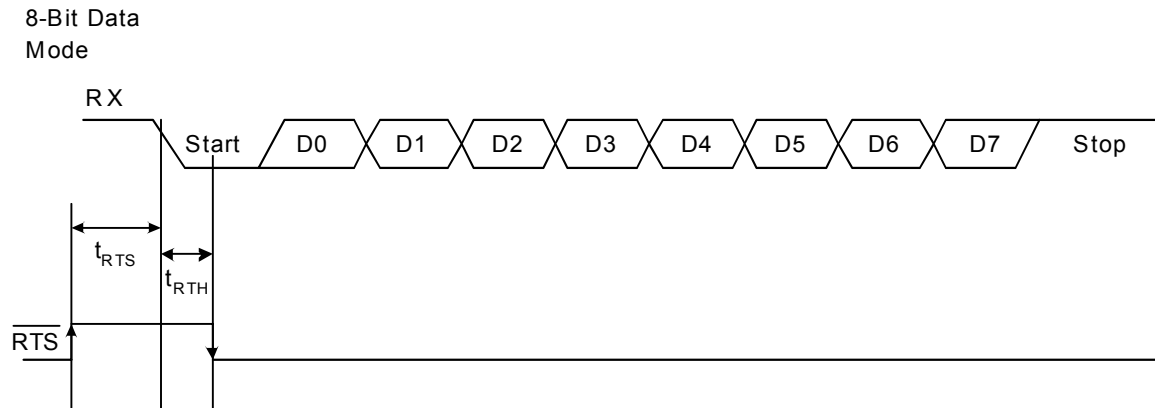
Table 6. Switching Characteristics

($V_D = 3.0$ to 3.6 V, $T_A = 0$ to 70 °C for F-Grade)

| Parameter | Symbol | Min | Typ | Max | Unit |
|--|------------|-------|---------------------------------|--------|------|
| CLKOUT Output Clock Frequency | | 2.048 | — | 49.152 | MHz |
| Baud Rate Accuracy | t_{BD} | -1 | — | 1 | % |
| Start Bit \downarrow to \overline{RTS} \downarrow | t_{RTH} | — | $1/(2 \times \text{Baud Rate})$ | — | ns |
| \overline{CTS} or \overline{RTS} \uparrow High to Start Bit \downarrow | t_{RTS} | 10 | — | — | ns |
| Stop Bit \uparrow to \overline{CTS} \uparrow | t_{CTH} | — | — | — | ns |
| \overline{RESET} \downarrow to \overline{RESET} \uparrow | t_{RS} | 5.0 | — | — | ms |
| \overline{RESET} \uparrow to 1st AT Command | t_{AT} | 300 | — | — | ms |
| Address Setup | t_{AS} | 15 | — | — | ns |
| Address Hold | t_{AH} | 0 | — | — | ns |
| \overline{WR} Low Pulse Width | t_{WL} | 50 | — | — | ns |
| Write Data Setup Time | t_{WDSU} | 20 | — | — | ns |
| Write Cycle Time | t_{WC} | 120 | — | — | ns |
| Chip Select Setup | t_{CSS} | 10 | — | — | ns |
| Chip Select Hold | t_{CSH} | 0 | — | — | ns |
| \overline{RD} Low Pulse Width | t_{RL} | 50 | — | — | ns |
| \overline{RD} Low to Data Driven Time | t_{RLDD} | — | — | 20 | ns |
| Data Hold | t_{DH} | 10 | — | — | ns |
| \overline{RD} High to Hi-Z Time | t_{DZ} | — | — | 30 | ns |
| Read Cycle Time | t_{RC} | 120 | — | — | ns |

Note: All timing is referenced to the 50% level of the waveform. Input test levels are $V_{IH} = V_D - 0.4$ V, $V_{IL} = 0.4$ V

UART Time for Modem Receive Path (8N1 Mode)



UART Timing for Modem Transmit Path (9N1 Mode with 9th Bit Escape)

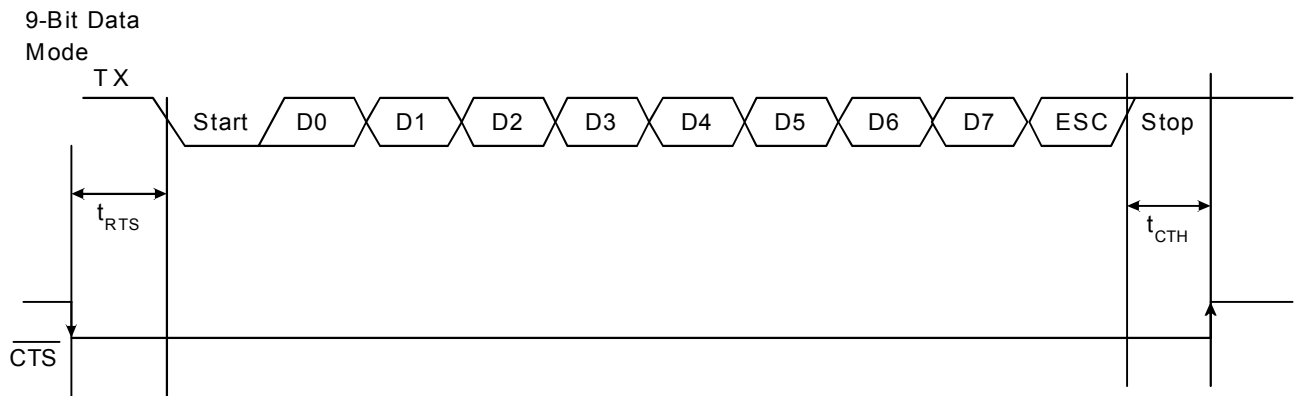


Figure 2. Asynchronous UART Serial Interface Timing Diagram

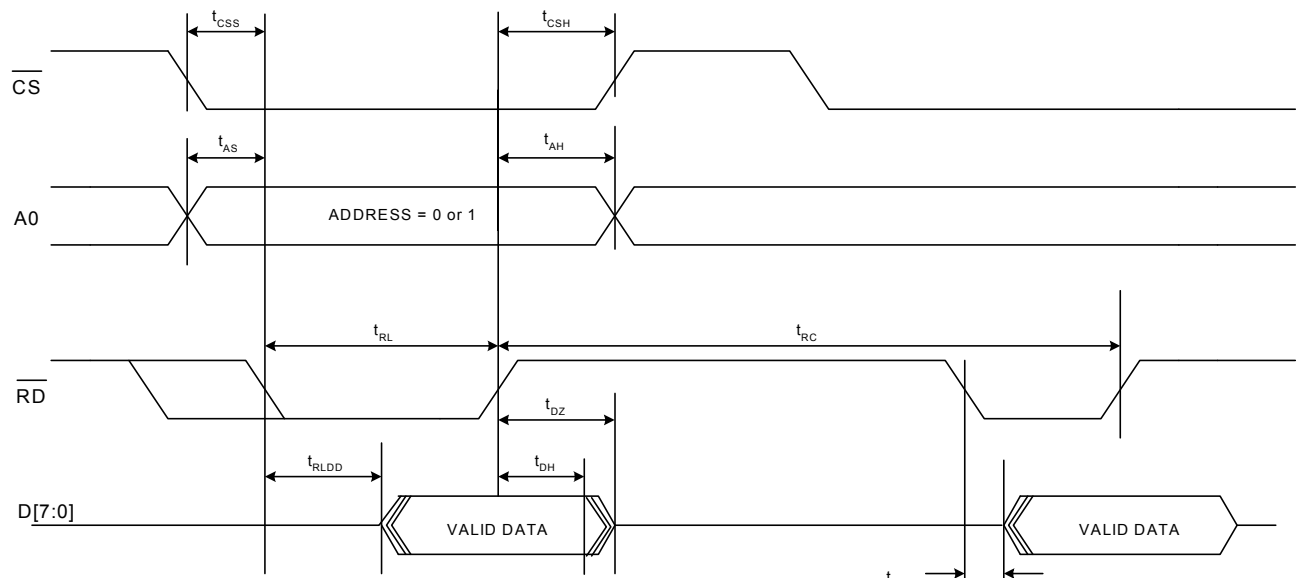


Figure 3. Parallel Interface Read Timing

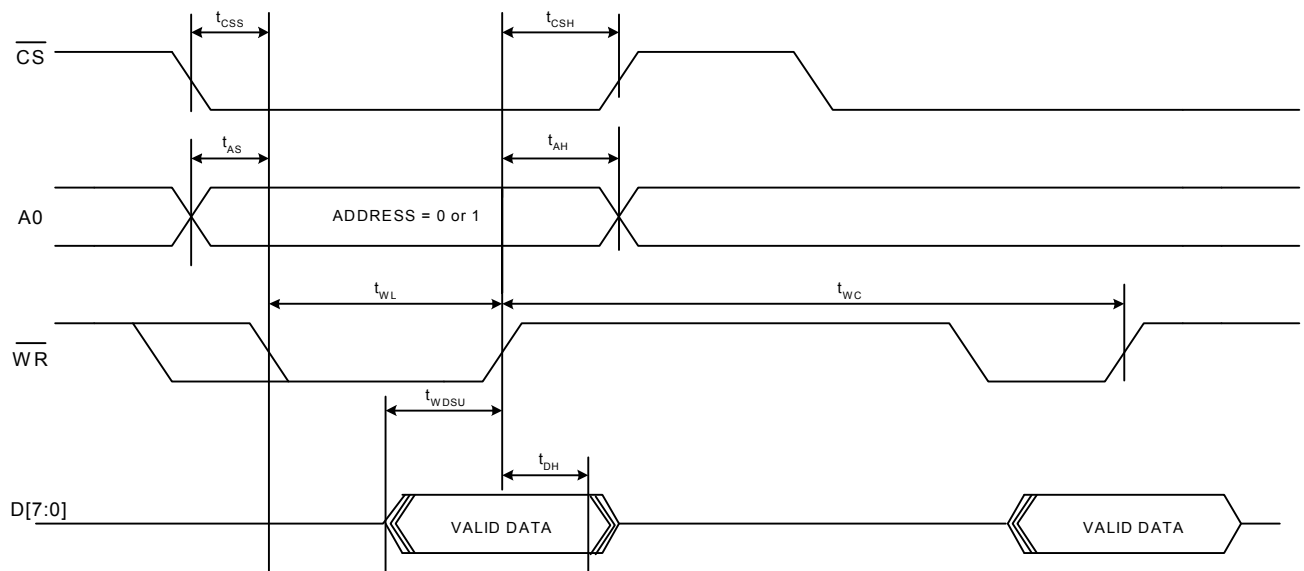
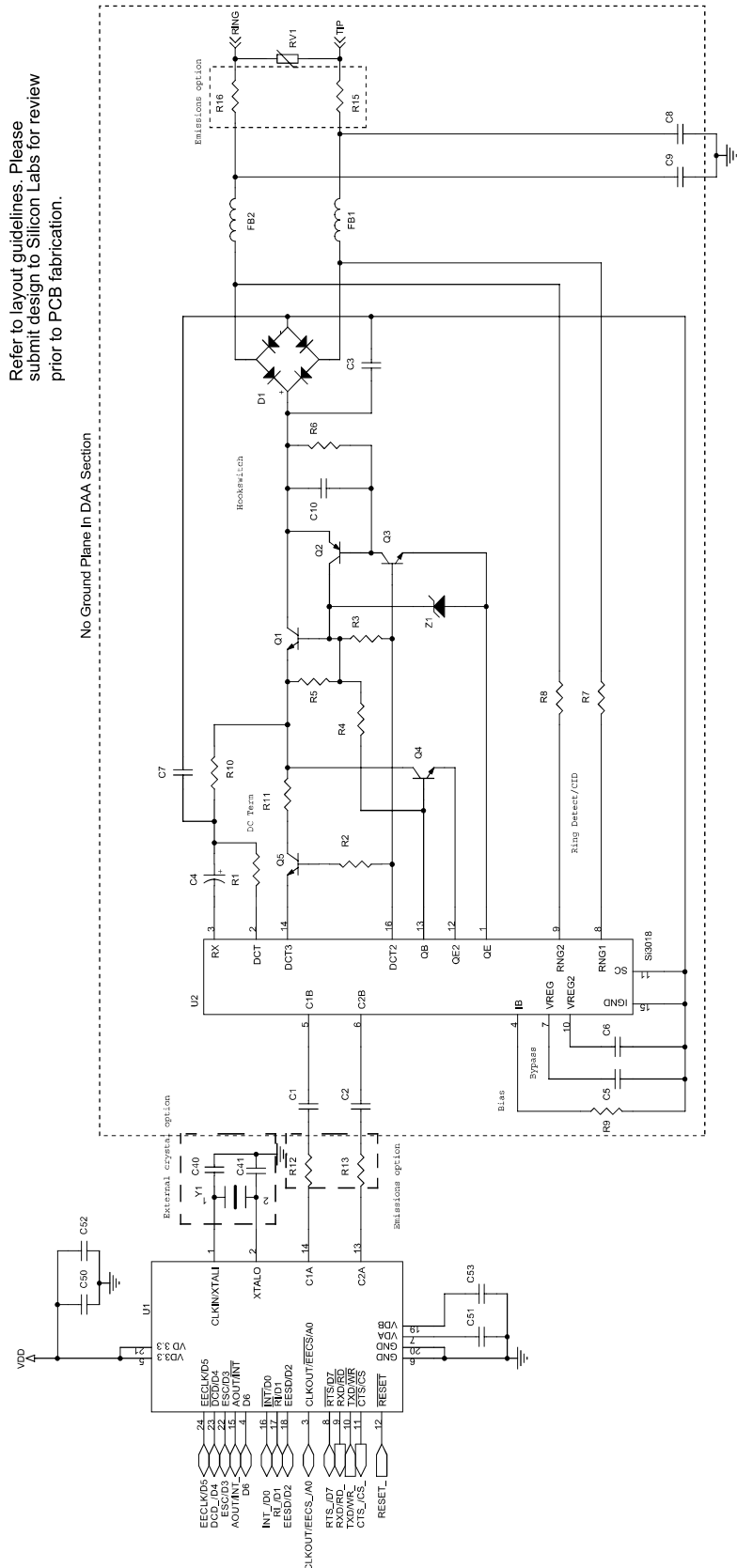


Figure 4. Parallel Interface Write Timing

2. Typical Application Schematic



3. Bill of Materials: Si2435/17 Chipset

| Component | Value | Supplier(s) |
|-----------------------|---------------------------------------|---------------------------|
| C1, C2 | 33 pF, Y2, X7R, ±20% | Panasonic, Murata, Vishay |
| C3 | 10 nF, 250 V, X7R, ±20% | Venkel, SMEC |
| C4 | 1.0 μF, 50 V, Elec/Tant, ±20% | Panasonic |
| C5, C6, C50, C52 | 0.1 μF, 16 V, X7R, ±20% | Venkel, SMEC |
| C7 | 2.7 nF, 50 V, X7R, ±20% | Venkel, SMEC |
| C8, C9 | 680 pF, Y2, X7R, ±10% | Panasonic, Murata, Vishay |
| C10 | 0.01 μF, 16 V, X7R, ±20% | Venkel, SMEC |
| C40, C41 ¹ | 33 pF, 16 V, X7R, ±20% | Venkel, SMEC |
| C51, C53 | 0.22 μF, 16 V, X7R, ±20% | Venkel, SMEC |
| D1, D2 ² | Dual Diode, 225 mA, 300 V, CMPD2004S | Central Semiconductor |
| FB1, FB2 | Ferrite Bead, BLM21AG601SN1 | Murata |
| Q1, Q3 | NPN, 300 V, MMBTA42 | OnSemi, Fairchild |
| Q2 | PNP, 300 V, MMBTA92 | OnSemi, Fairchild |
| Q4, Q5 | NPN, 80 V, 330 mW, MMBTA06 | OnSemi, Fairchild |
| RV1 | Sidactor, 275 V, 100 A | Teccor, Protek, ST Micro |
| R1 | 1.07 kΩ, 1/2 W, 1% | Venkel, SMEC, Panasonic |
| R2 | 150 Ω, 1/16 W, 5% | Venkel, SMEC, Panasonic |
| R3 | 3.65 kΩ, 1/2 W, 1% | Venkel, SMEC, Panasonic |
| R4 | 2.49 kΩ, 1/2 W, 1% | Venkel, SMEC, Panasonic |
| R5, R6 | 100 kΩ, 1/16 W, 5% | Venkel, SMEC, Panasonic |
| R7, R8 | 20 MΩ, 1/16 W, 5% | Venkel, SMEC, Panasonic |
| R9 | 1 MΩ, 1/16 W, 1% | Venkel, SMEC, Panasonic |
| R10 | 536 Ω, 1/4 W, 1% | Venkel, SMEC, Panasonic |
| R11 | 73.2 Ω, 1/2 W, 1% | Venkel, SMEC, Panasonic |
| R12, R13 ³ | 0 Ω, 1/16 W | Venkel, SMEC, Panasonic |
| R15, R16 ⁴ | 0 Ω, 1/16 W | Venkel, SMEC, Panasonic |
| U1 | Si2435/17 | Silicon Labs |
| U2 | Si3018 | Silicon Labs |
| Y1 ^{1,5} | 4.9152 MHz, 20 pF, 100 ppm, 150 Ω ESR | ECS Inc., Siward |
| Z1 | Zener Diode, 43 V, 1/2 W, BZT84C43 | On Semi |

Notes:

1. In STB applications, C40, C41, and Y1 can be removed by using the 27 MHz clock input feature.
2. Several diode bridge configurations are acceptable. For example, a single DF04S or four 1N4004 diodes may be used.
3. 56 Ω, 1/16 W, 1% resistors may be substituted for R12–R13 (0 Ω) to decrease emissions.
4. Murata BLM21AG601SN1 may be substituted for R15–R16 (0 Ω) to decrease emissions.
5. To ensure compliance with ITU specifications, frequency tolerance must be less than 100 ppm including initial accuracy, 5-year aging, 0 to 70 °C, and capacitive loading. 50 ppm initial accuracy crystals typically satisfy this requirement.

Table 7. Protocol Characteristics

| Item | Specification |
|---|--|
| Fax Rate 33.6 kbps* 31.2 kbps* 28.8 kbps* 26.4 kbps* 24.0 kbps* 21.6 kbps* 19.2 kbps* 16.8 kbps* 14.4 kbps 12.0 kbps 9600 bps 7200 bps 4800 bps 2400 bps | ITU-T V.34* ITU-T V.34* ITU-T V.34* ITU-T V.34* ITU-T V.34* ITU-T V.34* ITU-T V.34* ITU-T V.34* ITU-T V.34* ITU-T V.34*, or V.17 ITU-T V.34*, or V.17 ITU-T V.34*, V.29, or V.17 ITU-T V.34*, V.29, or V.17 ITU-T V.34*, or V.27ter ITU-T V.34*, V.22bis, or V.27ter |
| Control Channel 1200 bps 300 bps | ITU-T V.34bis* ITU-T V.21 channel 2 |
| Data Format Bit asynchronous | Selectable 8, 9, 10, or 11 bits per character |
| Fax Modulation 2.4 to 33.6 kbps* 7.2 to 14.4 kbps 7200 to 9600 bps 2400 to 4800 bps 300 bps | V.34 as specified by ITU-T V.17 TCM as specified by ITU-T V.29 QAM as specified by ITU-T V.27 ter DPSK as specified by ITU-T V.21 channel 2 FSK as specified by ITU-T |
| Transmit Carrier V.34* ITU-T V.29 ITU-T V.22 Originate mode Answer mode ITU-T V.21 Originate mode Answer mode | As specified by ITU-T 1700 Hz \pm 1 Hz 1200 Hz \pm 0.5 Hz 2400 Hz \pm 1 Hz Mark (980 Hz \pm 12 Hz) Space (1180 Hz \pm 12 Hz) Mark (1650 Hz \pm 12 Hz) Space (1850 Hz \pm 12 Hz) |
| *Note: Supported on Si2435 only. | |

Table 7. Protocol Characteristics (Continued)

| Item | Specification |
|---|--|
| Receive Carrier ITU-T V.34* ITU-T V.29 ITU-T V.22 Originate mode Answer mode ITU-T V.21 Originate mode Answer mode | As specified by ITU-T 1700 Hz \pm 7 Hz 2400 Hz \pm 7 Hz 1200 Hz \pm 7 Hz Mark (980 Hz \pm 12 Hz) Space (1180 Hz \pm 12 Hz) Mark (1650 Hz \pm 12 Hz) Space (1850 Hz \pm 12 Hz) |
| DTE Interface | EIA/TIA-232-E (ITU-T V.24/V.28/ISO 2110) |
| Line Equalization | Automatic Adaptive |
| Dialing | Pulse and Tone |
| *Note: Supported on Si2435 only. | |

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4. Functional Description

The Si2435/17 ISModem[®] is a complete embedded fax modem chipset with integrated direct access arrangement (DAA) that provides a programmable line interface to meet global telephone line requirements. Available in two small packages, this solution includes a DSP data pump, modem controller, on-chip RAM and ROM, codec, DAA, analog output, and 27 MHz clock input.

The Si2435/17 ISModem is a full-featured fax modem chipset offering ITU-T T.31 compliant class 1 commands with fax connect rates up to 33.6/14.4 kbps over the Public Switched Telephone Network (PSTN).

The ISModem provides numerous additional features for fax modem applications. The modem includes full type I caller ID and type II caller ID in snoop mode for global standards, a data/fax call discriminator, DTMF tone generation and detection, and call progress monitoring. The modem is also programmable to meet global settings. Because the Si2435/17 ISModem integrates the DAA, analog features, such as parallel phone detect, overcurrent detection, and global PTT compliance with a single design, are included.

This device is ideal for fax modem applications due to its small board space, low power consumption, and global compliance. The Si2435/17 solution includes a silicon DAA using Silicon Laboratories' proprietary third-generation DAA technology. This highly-integrated DAA can be programmed to meet worldwide PTT specifications for ac termination, dc termination, ringer impedance, and ringer threshold. In addition, the Si2435/17 has been designed to meet the most stringent worldwide requirements for out-of-band energy, billing-tone immunity, surge immunity, and safety requirements.

The Si2435/17 provides a serial interface that can directly communicate to either a microcontroller via a UART interface or a PC via an RS-232 port. This interface allows for PC evaluation of the modem immediately upon powerup via the AT commands using standard terminal software. The Si2435/17 also provides an 8-bit parallel port.

4.1. Digital Interface

The Si2435/17 digital I/O can communicate via either a serial UART interface with flow control or via a parallel 8-bit interface.

Selection of a serial or parallel I/O interface is determined by the state of AOUT/ $\overline{\text{INT}}$ (Si2435/17, pin 15) during the rising edge of $\overline{\text{RESET}}$. An internal pullup resistor forces the default state to serial mode operation. An external 10 k Ω pulldown resistor can be

connected to AOUT/ $\overline{\text{INT}}$ to force selection of parallel mode (see Table 8). Configuration of pins 3, 4, 8–11, 15–18, and 22–24 is determined by this interface selection.

4.2. Serial Interface

The Si2435/17 supports asynchronous serial communication with data terminal equipment (DTE) at rates up to 307.2 kbps with the standard serial UART format. Upon powerup, the UART baud rate is automatically detected using the autobaud feature.

The serial interface also provides a hardware pin, $\overline{\text{DCD}}$ (data carrier detect), which remains low as long as the ISModem is connected.

The $\overline{\text{INT}}$ interrupt pin can be programmed to alert the host of changes to the interrupts listed in I/O Control 0 (U70).

4.2.1. Autobaud

The Si2435/17 includes an automatic baud rate detection feature that allows the host to start transmitting data at any standard DTE rate from 300 bps to 307.2 kbps.

4.3. Parallel Interface

The parallel interface is an 8-bit data bus with a single bit address. Figure 3 on page 9 shows the required timing for the parallel interface.

If A0 = 0, the data bus represents a read/write to the "Parallel Interface 0 (0x00)" register on page 56. If A0 = 1, the data bus represents a read/write to the "Parallel Interface 1 (0x01)" register on page 57). See "AN60: Si2493/57/34/15/04 Parallel Interface Software" for details.

4.4. Command State

In command state, the ISModem is ready to accept commands from the host and is not communicating with a remote modem. Data signals from the host are treated as command lines, processed by the ISModem, and then, if appropriate, responses are sent back to the host. The command state is entered upon power-up and when a call is disconnected and is available in data mode, fax mode, or voice mode.

4.5. Data State

In data state, the ISModem is communicating with a remote modem. Data signals sent from the host are treated as data and transmitted to the remote modem via the ISModem, and data received from the remote modem are delivered via the ISModem to the host. Data and control signals are monitored by the ISModem to detect events, such as loss of the remote

connection and requests for disconnection or switching to command state. The data state is entered by successful completion of a command to originate or answer a call. For the Si2435/17 ISModem, data state is only operational in fax mode.

4.6. Data Mode (+FCLASS = 0)

The Si2435/17 has limited data mode support. In data mode, the Si2435/17 ISModem can be used for modem initialization and to detect incoming signals such as ringing and caller ID. The Si2435/17 does not support data modulations. If data modes are required, use the Si2457/34/15/04/01 ISModem family of devices. Data mode is enabled by the AT command, +FCLASS = 0, and is the default mode of operation.

4.7. Fax Mode (+FCLASS = 1)

The Si2435/17 fax ISModem supports super G3 (Si2435 only) and G3 fax communication. In fax mode, the Si2435 and Si2417 ISModem can answer or originate fax calls for speeds up to 33.6 kbps and 14.4 kbps respectively. Fax communication is supported through standard EIA/TIA 578 and ITU-T T.31 Class 1 AT commands, such as +FTM, +FRM, +FTH, +FRH, and +F34 (see Table 10 on page 18). Fax mode is enabled by the AT command +FCLASS = 1.

4.8. Voice Mode (+FCLASS = 8)

The Si2435/17 supports a voice mode. In voice mode, the ISModem monitors the telephone line for several events, such as DTMF detection, caller ID, and ringing tone. Once these events are detected, the ISModem will send either a simple event code (a single character) or a complex event code (multiple characters) preceded by a <DLE> character to the host. For a full list event reporting see Table 9. In voice mode, the ISModem can also generate DTMF and single tones using the +VTS command.

Voice mode is enabled by the AT command +FCLASS = 8. In voice mode, the +VLS command is used to enable event reporting and tone generation and to control the on/off hook state. Table 9 lists the events that are supported based on the +VLS state.

4.9. V.8 Call Establishment (Si2435 Only)

The Si2435 supports V.8 call establishment. Using the V.8 protocol, the Si2435 fax ISModem automatically negotiates with the remote modem for the best possible operational mode and speed. Upon successful V.34HD call establishment, the Si2435 will echo a "+F34: <rate>" response code prior to the CONNECT message.

To ensure interoperability with legacy G3 Fax Machines, if the remote modem does not support V.8, the Si2435 fax ISModem enters the command state to allow the host to initiate G3 operation as described in T.30. The Si2435 echoes an "OK" response code signifying the entrance to the command state. If enabled, the +A8 response codes can be sent to assist the host in determining the appropriate action.

If a fallback to G3 occurs, the host can optionally command the Si2435 to perform a V.8 retry via the AT+FTH=FSKL or AT+FRH=FSKL command. A V.8 retry allows for a possible transition back to V34HD Fax operation if V.8 negotiation fails, for instance, due to an ANSam misdetection during a manual call establishment described in the T.30 standard.

4.10. Data / Fax / Voice Discriminator

The Si2435/17 supports data/fax/voice discrimination via tone detection. In voice mode (+FCLASS = 8), if tone detection is enabled, the ISModem will report a "c" when fax calling tones are detected (1100 Hz). The ISModem will report an "e" when data calling tones are detected (1300 Hz). A "q" is reported when no tones are present for a preset amount of time. This "quiet" detection is generally perceived as a voice call. Using these event reports, the host can distinguish between a voice, data, or fax call.

4.11. DTMF Detection / Generation

The Si2435/17 provides comprehensive DTMF tone generation and detection. The ISModem can generate single tones or DTMF tones using the +VTS command. DTMF tones may also be generated during dialing using the "ATDT" command. DTMF detection is only available in voice mode (FCLASS = 8). DTMF digits are reported from the modem to the host using <DLE> shielding.

4.12. Caller ID Operation

The Si2435/17 fax ISModem supports global caller ID decode including US Bellcore, European ETSI, UK, Japanese, and DTMF protocols. The caller ID type is set using the +VCDT command. For example, +VCDT = 0 is Bellcore, +VCDT = 2 is UK and +VCDT = 3 is Japan caller ID mode. In addition, the Si2435/17 has an "always on" caller ID mode (+VCDT = 1), which snoops the line for data. This mode can be used for type II caller ID or non-standard caller ID implementations. The +VCID command is used to enable or disable caller ID formatting (see Table 10 on page 18 for more details).

4.13. Parallel Phone Detection

In voice mode, the Si2435/17 ISModem will automatically and unobtrusively detect when another telephone, modem, or other device is using the phone line. The ISModem will echo a <DLE>"P" if a remote device goes off-hook and will echo a <DLE>"p" when the remote device goes back on-hook. This allows the host to avoid interrupting another phone call when the phone line is already in use and to intelligently handle an interruption when the ISModem is utilizing the phone line.

4.14. Overcurrent Detection

The Si2435/17 includes an overcurrent detection feature that measures the loop current at a programmable time after the Si2435/17 goes off-hook. This allows the Si2435/17 to detect if it is connected to an improper telephone line. The overcurrent detection feature may be enabled by setting the OCDM bit (U70, bit 11). OHT (U77, bits 8:0) sets the delay after off-hook until the loop current is measured.

4.15. Global Operation

The Si2435/17 chipset contains an integrated silicon direct access arrangement (DAA) that provides a programmable line interface to meet international telephone line interface requirements.

Additionally, the user-access registers (via the AT:U and AT:R commands) may be programmed for country-specific settings, such as dial tone, ring, ringback, and busy tone.

4.16. Clocking

The Si2435/17 contains an on-chip phase-locked loop (PLL) and clock generator. Using either a single crystal or master clock input, the Si2435/17 can generate all the internal clocks required to support the featured modem protocols. Either a 27 MHz or 4.9152 MHz clock (3.3 V max input—see Table 5 on page 7) on XTALI or a 4.9152 MHz crystal across XTALI and XTALO form the master clock (± 100 ppm max) for the ISModem. This

clock source is sent to an internal PLL that generates all necessary internal system clocks including the DSP clock.

By default, the Si2435/17 assumes a 4.9152 MHz clock input. If a 27 MHz clock on XTALI is used with the serial (UART) interface, a pulldown resistor ≤ 10 k Ω must be placed between DCD (pin 23) and GND. If a 27 MHz clock on XTALI is used with the parallel interface, a pulldown resistor ≤ 10 k Ω must be placed between CTS/CS (pin 11) and GND and AOUT/INT and GND (see Table 8).

Table 8. Pulldown Selector

| Mode | Serial I/O | Parallel I/O |
|----------------|------------|--------------|
| 4.9152 MHz CLK | Default | Pin 15 |
| 27 MHz CLK | Pin 23 | Pin 11, 15 |

4.17. Low-Power Modes

In order to reduce power consumption, the Si2435/17 fax ISModem may be placed in a wake-on-ring/sleep mode, or a complete powerdown mode. The sleep mode may be entered via the AT&Z command. Once the AT&Z command is issued, the ISModem will remain in sleep mode until either a ring is detected (triggering the INT pin and toggling the Ring Indicator (RI) bit low in U70) or a write to the TX FIFO. The ISModem may also be wakened out of sleep mode by a caller ID event.

Alternately, using the S24 S-register, the Si2435/17 can be set to automatically enter sleep mode after a pre-programmed time of inactivity with either the DTE or the remote modem. The sleep mode is entered after (S24) seconds have passed since the TX FIFO has been empty. Complete powerdown is accomplished via U65[13] (PDN). Once the PDN bit is written, the Si2435/17 completely powers down and can only be powered back on via the RESET pin.

Table 9. V.253 Event Reporting in Voice Mode

| Event Description | Reporting | +VLS |
|--|-------------|---------------|
| Caller Id Report | Complex | 0,4,20,21 |
| Distinctive Ringing | Complex | 0,4,20,21 |
| RING | R | 0,4,20,21 |
| DTMF Received | 1-9,A-D,*,# | 1,5,20,21 |
| Facsimile Calling (e.g. 1100 Hz) | c | 1,5,20,21 |
| Data Calling (e.g. 1300 Hz) | e | 1,5,20,21 |
| Presumed End of Message (QUIET) Time-out | q | 1,5,20,21 |
| Loop Current Interruption | l | 1,5,20,21 |
| Ringing Tone | r | 1,5,20,21 |
| BUSY | b | 1,5,20,21 |
| DIALTONE | d | 1,5,20,21 |
| Extension Phone On-hook | p | 0,1,4,5,20,21 |
| Extension Phone Off-hook | P | 0,1,4,5,20,21 |
| Facsimile or Data Answer (e.g. 2100 Hz) | a | 1,5,20,21 |
| Data Answer (e.g. 2225 Hz) | f | 1,5,20,21 |

4.18. Firmware Upgrades

The Si2435/17 contains an on-chip program ROM that includes the firmware required for the features listed in this data sheet. In addition, the Si2435/17 contains on-chip program RAM to accommodate minor changes to the firmware. This allows Silicon Labs to provide future firmware updates to optimize the characteristics of new modem designs and those already deployed in the field.

4.19. Codec Interface

The Si2435/17 includes an optional serial interface that connects to an external voice codec (Si3000) for handset support.

4.20. AT Commands

At powerup, the Si2435/17 is in the AT command mode. In command mode, the modem monitors the input (serial or parallel) checking constantly for a valid command (AT commands are described in Table 10.)

Table 10. Basic AT Command Set (Command Defaults in Bold)

| Command | Action | | | | | | | | | | | | | | | | | | |
|---|--|----------|----------|--------|--|--------|---|---|---------------------------|---|-------------------|---|---------------------|---|---|---|--|---|--|
| \$ | Display AT command mode settings. | | | | | | | | | | | | | | | | | | |
| A | Answer incoming call | | | | | | | | | | | | | | | | | | |
| A/ | Re-execute last command. This is the only command not preceded by “AT” or followed by a <CR>. | | | | | | | | | | | | | | | | | | |
| Dn | <p>Dial</p> <p>The dial command, followed by 1 or more dial command modifiers, manually dials a phone number:</p> <table border="1"> <thead> <tr> <th>Modifier</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>! or &</td> <td>Flash hook switch for FHT (U4F) ms (default: 500 ms)</td> </tr> <tr> <td>, or <</td> <td>Pause before continuing for S8 seconds (default: 2 seconds)</td> </tr> <tr> <td>;</td> <td>Return to AT command mode</td> </tr> <tr> <td>@</td> <td>Wait for silence.</td> </tr> <tr> <td>L</td> <td>Redial last number.</td> </tr> <tr> <td>P</td> <td>Pulse (rotary) dialing—pulse digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9</td> </tr> <tr> <td>T</td> <td>Tone (DTMF) dialing—DTMF digits: *, #, A, B, C, D, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.</td> </tr> <tr> <td>W</td> <td> <p>Wait for dial tone before continuing for S14 seconds (default: 12 seconds). Blind dialing modes X0, X1 and X3 do not affect the W command.</p> <p>If the DOP bit (U7A, bit 7) is set, the “ATDTW” command will cause the ISModem® to pause dialing and either report an “OK” if a dialtone is detected or “NO DIALTONE” if a dial tone is not detected.</p> </td> </tr> </tbody> </table> | Modifier | Function | ! or & | Flash hook switch for FHT (U4F) ms (default: 500 ms) | , or < | Pause before continuing for S8 seconds (default: 2 seconds) | ; | Return to AT command mode | @ | Wait for silence. | L | Redial last number. | P | Pulse (rotary) dialing—pulse digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 | T | Tone (DTMF) dialing—DTMF digits: *, #, A, B, C, D, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. | W | <p>Wait for dial tone before continuing for S14 seconds (default: 12 seconds). Blind dialing modes X0, X1 and X3 do not affect the W command.</p> <p>If the DOP bit (U7A, bit 7) is set, the “ATDTW” command will cause the ISModem® to pause dialing and either report an “OK” if a dialtone is detected or “NO DIALTONE” if a dial tone is not detected.</p> |
| Modifier | Function | | | | | | | | | | | | | | | | | | |
| ! or & | Flash hook switch for FHT (U4F) ms (default: 500 ms) | | | | | | | | | | | | | | | | | | |
| , or < | Pause before continuing for S8 seconds (default: 2 seconds) | | | | | | | | | | | | | | | | | | |
| ; | Return to AT command mode | | | | | | | | | | | | | | | | | | |
| @ | Wait for silence. | | | | | | | | | | | | | | | | | | |
| L | Redial last number. | | | | | | | | | | | | | | | | | | |
| P | Pulse (rotary) dialing—pulse digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 | | | | | | | | | | | | | | | | | | |
| T | Tone (DTMF) dialing—DTMF digits: *, #, A, B, C, D, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. | | | | | | | | | | | | | | | | | | |
| W | <p>Wait for dial tone before continuing for S14 seconds (default: 12 seconds). Blind dialing modes X0, X1 and X3 do not affect the W command.</p> <p>If the DOP bit (U7A, bit 7) is set, the “ATDTW” command will cause the ISModem® to pause dialing and either report an “OK” if a dialtone is detected or “NO DIALTONE” if a dial tone is not detected.</p> | | | | | | | | | | | | | | | | | | |
| En | Local DTE echo | | | | | | | | | | | | | | | | | | |
| E0 | Disable | | | | | | | | | | | | | | | | | | |
| E1 | Enable | | | | | | | | | | | | | | | | | | |
| Hn | Hook switch. | | | | | | | | | | | | | | | | | | |
| H0 | Go on-hook (hang up modem). | | | | | | | | | | | | | | | | | | |
| H1 | Go off-hook. | | | | | | | | | | | | | | | | | | |
| In | Identification and checksum. | | | | | | | | | | | | | | | | | | |
| I0 | <p>Display Si2435/17 revision code.</p> <p>A: Revision A</p> <p>B: Revision B, etc.</p> | | | | | | | | | | | | | | | | | | |
| I1 | Display Si2435/17 firmware revision code (numeric). | | | | | | | | | | | | | | | | | | |
| I3 | <p>Display line-side revision code.</p> <p>18F = Si3018 revision F</p> | | | | | | | | | | | | | | | | | | |
| I6 | <p>Display the ISModem® model number.</p> <p>“2417” = Si2417</p> <p>“2435” = Si2435</p> | | | | | | | | | | | | | | | | | | |
| I7 | Diagnostic results 1. | | | | | | | | | | | | | | | | | | |
| <p>*Note: This command should only be issued when the Si2435/17 is off-hook.</p> | | | | | | | | | | | | | | | | | | | |

Table 10. Basic AT Command Set (Command Defaults in Bold) (Continued)

| Command | Action |
|--|---|
| I8 | Diagnostic results 2. |
| Ln | Speaker volume operation |
| L1 | Low speaker volume |
| L2 | Medium speaker volume |
| L3 | High speaker volume |
| Mn | Speaker operation (via AOUT). |
| M0 | Speaker is always off. |
| M1 | Speaker is on while dialing and handshaking; off in data mode. |
| M2 | Speaker is always on. |
| M3 | Speaker is off while dialing, on during handshaking and retraining. |
| Qn | Response mode. |
| Q0 | Enable result codes (see Table 12 on page 30) |
| Q1 | Disable result codes (enable quiet mode). |
| Sn | S-register operation (see Table 13 on page 32). |
| S\$ | List contents of all S registers. |
| Sn? | Display contents of S-register n. |
| Sn=x | Set S-register n to value x (where n and x are decimal values). |
| Vn | Result code type (see Table 12 on page 30). |
| V0 | Numeric result codes. |
| V1 | Verbal result codes |
| Xn | Call Progress Monitor (CPM)—This command controls which CPM signals are monitored and reported to the host from the Si2435/17. (See Table 12 on page 30.) |
| X0 | Basic results; disable CPM—Blind dial (does not wait for dial tone). CONNECT message does not include speed. |
| X1 | Extended results; disable CPM—Blind dial. CONNECT message includes speed. |
| X2 | Extended results and detect dial tone only—Add dial tone detection to X1 mode. Does not blind dial. |
| X3 | Extended results and detect busy only—Add busy tone detection to X1 mode. |
| X4 | Extended results, full CPM—Full CPM enabled, CONNECT message includes speed. |
| X5 | Extended results—Full CPM enabled including ringback detection. Adds ringback detection to X4 mode. |
| Z | Hard Reset—This command is functionally equivalent to pulsing the RESET pin low. (See t _{AT} in Table 6 on page 7.) |
| &\$ | Display AT& current settings. |
| &D0 | ESC (pin 22) is not used |
| &D1 | ESC (pin 22) escapes to command mode from data mode if also enabled by HES U70, bit 15. |
| &D2 | ESC (pin 22) assertion during a modem connection causes the modem to go on-hook and return to command mode. |
| *Note: This command should only be issued when the Si2435/17 is off-hook. | |

Table 10. Basic AT Command Set (Command Defaults in Bold) (Continued)

| Command | Action |
|---|---|
| &D3 | ESC (pin 22) assertion causes ATZ command (reset and return OK result code). |
| &F | Restore factory default settings. |
| &Pn | Japan pulse dialing |
| &P0 | Configure Si2435/17 for 10 pulse-per-second pulse dialing. For Japan. |
| &P1 | Configure Si2435/17 for 20 pulse-per-second pulse dialing. For Japan. |
| &Tn | Test mode |
| &T0 | Cancel test mode (Escape to command mode to issue AT&T0). This command will also report the number of bit errors encountered on the previous &T4 or &T5 test. |
| &T2 | Initiate ITU-T V.54 (ANALOO) test. Modulation set by +MS AT command. Test loop is through the DSP (Si2435/17 device) only. ISModem® echoes data from TX pin (Register 0 in parallel mode) back to RX pin (Register 0 in parallel mode). |
| &T3 | Initiate ITU-T V.54 (ANALOO) test. Modulation set by +MS AT command. Test loop is through the DSP (Si2435/17), DAA interface section (Si2435/17), DAA interface (Si3018), and analog hybrid circuit (Si3018). ISModem echoes data from TX pin (Register 0 in parallel mode) back to RX pin (Register 0 in parallel mode). Phone line termination required as in Figure 1. To test only the link operation, the hybrid and AFE codec can be removed from the test loop by setting the DL bit (U62, bit 1). |
| &T4 | Initiate transmit as originating modem with automatic data generation. Modulation, data rate, and symbol rate are set by +MS and S41. Data pattern is set by the S40 register. Continues until the ATH command is sent after an escape into command mode. Data is also demodulated as in ANALOO, and any bit errors are counted to be displayed after the test using &T0. |
| &T5 | Initiate transmit as answering modem with automatic data generation. Modulation, data rate, and symbol rate are set by +MS and S41. Data pattern is set by the S40 register. Continues until the ATH command is sent after an escape into command mode. Data is also demodulated as in ANALOO, and any bit errors are counted to be displayed after the test using &T0. |
| &T6 | Compute checksum for firmware-upgradeable section of program memory. If no firmware upgrade is installed, &T6 returns 0x4474. |
| &Z | Enter low-power wake-on-ring mode. |
| \\$ | Display AT\ command settings. |
| \Bn | Character length will be automatically set in autobaud mode |
| \B0 | 6N1—six data bits, no parity, one stop bit, one start bit, eight bits total (\N0 only) ¹ |
| \B1 | 7N1—seven data bits, no parity, one stop bit, one start bit, nine bits total (\N0 only) ¹ |
| \B2 | 7P1—seven data bits, parity optioned by \P, one stop bit, one start bit, 10 bits total |
| \B3 | 8N1—eight data bits, no parity, one stop bit, one start bit, 10 bits total |
| \B5 | 8P1—eight data bits, parity optioned by \P, one stop bit, one start bit, 11 bits total (\N0 only) |
| \B6 | 8X1—eight data bits, one escape bit, one stop bit, one start bit, 11 bits total (enables ninth-bit escape mode) |
| \Pn | Parity type will be automatically set in autobaud mode |
| \P0 | Even |
| *Note: This command should only be issued when the Si2435/17 is off-hook. | |

Table 10. Basic AT Command Set (Command Defaults in Bold) (Continued)

| Command | Action | | | | | | | | |
|--|---|---------------------|---------------|------------------------|--------------------------------------|---------------------------|--|-----------------|---|
| \P1 | Space ¹ | | | | | | | | |
| \P2 | Odd | | | | | | | | |
| \P3 | Mark ¹ | | | | | | | | |
| \U | Serial mode—causes a low pulse (25 ms) on \overline{RI} and \overline{DCD} . \overline{INT} to be the inverse of ESC. \overline{RTS} to be inverse of \overline{CTS} . Parallel mode—causes a low pulse (25 ms) on \overline{INT} . This command terminates with a \overline{RESET} . | | | | | | | | |
| \Vn | Connect message type | | | | | | | | |
| \V0 | Report connect message and protocol message | | | | | | | | |
| \V2 | Report connect message only (exclude protocol message) | | | | | | | | |
| \V4 | Report connect and protocol message with both upstream and downstream connect rates. | | | | | | | | |
| %%\$ | Display AT% command settings. | | | | | | | | |
| %Vn | Automatic Line Status Detection. After the %V1 and %V2 commands are issued, the Si2435/17 will automatically check the telephone connection for whether or not a line is present. If a line is present, the Si2435/17 will automatically check if the line is already in use. Finally, the Si2435/17 will check line status both before going off-hook and again before dialing. | | | | | | | | |
| %V0 | Disable automatic line-in-use detection. | | | | | | | | |
| %V1 | Automatic Line Status Detection. Description: Before going off-hook with the ATD, ATO, or ATA commands, the Si2435/17 compares the line voltage (via LVS) to registers NOLN (U83) and LIUS (U84): <table border="0"> <tr> <td><u>Loop Voltage</u></td> <td><u>Action</u></td> </tr> <tr> <td>$0 \leq LVS \leq NOLN$</td> <td>Report “NO LINE” and remain on-hook.</td> </tr> <tr> <td>$NOLN \leq LVS \leq LIUS$</td> <td>Report “LINE IN USE” and remain on-hook.</td> </tr> <tr> <td>$LIUS \leq LVS$</td> <td>Go off-hook and establish a modem connection.</td> </tr> </table> Once the call has begun, the off-hook intrusion algorithm operates normally. In addition, the Si2435/17 will report “NO LINE” if the telephone line is completely disconnected. If the HOI bit (U77, bit 11) is set, “LINE IN USE” is reported upon intrusion. | <u>Loop Voltage</u> | <u>Action</u> | $0 \leq LVS \leq NOLN$ | Report “NO LINE” and remain on-hook. | $NOLN \leq LVS \leq LIUS$ | Report “LINE IN USE” and remain on-hook. | $LIUS \leq LVS$ | Go off-hook and establish a modem connection. |
| <u>Loop Voltage</u> | <u>Action</u> | | | | | | | | |
| $0 \leq LVS \leq NOLN$ | Report “NO LINE” and remain on-hook. | | | | | | | | |
| $NOLN \leq LVS \leq LIUS$ | Report “LINE IN USE” and remain on-hook. | | | | | | | | |
| $LIUS \leq LVS$ | Go off-hook and establish a modem connection. | | | | | | | | |
| :I | Interrupt Read—This command causes the ISOmodem® to report the lower 8 bits of the interrupt register I/O Control 0 (U70). The CID, OCD, PPD, and RI bits also are cleared, and the INT pin (INT bit in parallel mode) is deactivated on this read. | | | | | | | | |
| :P | Program RAM Write—This command is used to upload firmware supplied by Silicon Labs to the Si2435/17. The format for this command is AT:Paaaa,xxxx,yyyy,.... where aaaa is the first address in hexadecimal and xxxx,yyyy,.... is data in hexadecimal. Only one :P command is allowed per AT command line. No other commands can be concatenated in the :P command line. This command is <i>only</i> for use with special files provided by Silicon Laboratories. Do not attempt to use this command for any other purpose. | | | | | | | | |
| :R | User-Access Register Read—This command allows the user to read from the user-access registers. (See pages 35–55.) The format is “AT:Raa”, where aa = user-access address in hexadecimal. The “AT:R” command causes all the U- registers to be displayed. | | | | | | | | |
| *Note: This command should only be issued when the Si2435/17 is off-hook. | | | | | | | | | |

Table 10. Basic AT Command Set (Command Defaults in Bold) (Continued)

| Command | Action |
|--|---|
| :U | User-Access Register Write—This command allows the user to write to the 16-bit user-access registers. (See page 35.) The format is “AT:Uaa,xxx,yyy,zzz,...” where aa = user-access address in hexadecimal. xxx = Data in hexadecimal to be written to location aa. yyy = Data in hexadecimal to be written to location (aa + 1). zzz = Data in hexadecimal to be written to location (aa + 2). etc. |
| +A8A : <value> | Answer signal indication <u><value></u> <u>Description</u> 0 Indicates that the ISModem timed out waiting for an answering signal 1 Indicates V.8 ANSam signal (2100 Hz with amplitude modulation) 2 Indicates V.25 answer tone (2100 Hz) 5 Indicates sigA signal: V.22bis USB1 signal 6 Indicates sigA signal: V.32bis AC signal |
| +A8C : <value> | Calling tone indication <u><value></u> <u>Description</u> 0 Indicates that the ISModem concluded answer tone transmission without reporting detection of any calling tone 1 Indicates a CNG tone (1100 Hz) 2 Indicates 1300 Hz V.25 data modem calling tone |
| +A8E = <v8o>,<v8a> | V.8 operation control <u><v8o></u> <u>Description</u> 1 Enable ISModem controlled V.8 origination negotiation 6 Enable ISModem controlled V.8 origination negotiation, issue +A8x indications <u><v8a></u> <u>Description</u> 1 Enable ISModem controlled V.8 answer negotiation 5 Enable ISModem controlled V.8 answer negotiation, issue +A8x indications |
| +A8J: <value> | V.8 negotiation complete <u><value></u> <u>Description</u> 0 Indicates that the ISModem timed out waiting for a CJ signal 1 Indicates a CJ signal has been received by the remote modem |
| +A8M: <value> | V.8 menu report <u><value></u> <u>Description</u> 0 Indicates that the ISModem timed out waiting for a CM or JM signal <CM/JM hex string> This string is issued by either modem to indicate the contents of a valid received CM or JM signal. |
| +FCLASS = n | Fax mode select <u>n</u> <u>Mode</u> 0 Data mode 1 Fax class 1 / 1.0 mode 1.0 Fax class 1 / 1.0 mode 8 Voice mode |
| *Note: This command should only be issued when the Si2435/17 is off-hook. | |

Table 10. Basic AT Command Set (Command Defaults in Bold) (Continued)

| Command | Action |
|--|--|
| +FMI? | Report manufacturer ID. "Silicon Laboratories" |
| +FMM? | Report ISModem chipset model. <system-side> / <line-side> For example – "Si2435 / Si3018" |
| +FMR? | Report ISModem chipset revision. <system-side rev> / <line-side rev> For example – "A / F" |
| +FRH = n* | Receive Data with HDLC framing and carrier n. Only mandatory carrier, n = 3, supported. |
| +FRM = n* | Receive Data with carrier n. (See Table 11) |
| +FRS = n* | Report back to the DTE with an OK result code after n 10 ms intervals of silence have been detected on the line. |
| +FTH = n* | Transmit Data with HDLC framing and carrier n. Only mandatory carrier, n = 3, supported. |
| +FTM = n* | Transmit Data with carrier n. (See Table 11) |
| +FTS = n* | Stop transition and wait for n 10 ms intervals before responding with the OK result code. |
| +F34 options +F34 = A +F34 = A,B | Initial V.34 rate control This command is used to transmit or receive V.34 half-duplex data. V.34 full-duplex is not supported. The control channel remains fixed at 1200 bps. Upon a successful negotiation, a "+F34: <rate>" response code will be echoed. A Max rate for the primary channel in half-duplex operation. Values range from 1 (2400 bps) to 14 (33.6 kbps) in 2400 bps increments. The default value 0 selects a max rate of 33.6 kbps. B Min rate for the primary channel in half-duplex operation. Values range from 1 (2400 bps) to 14 (33.6 kbps) in 2400 bps increments. The default value 0 selects a min rate of 2400 bps. |
| *Note: This command should only be issued when the Si2435/17 is off-hook. | |

Table 10. Basic AT Command Set (Command Defaults in Bold) (Continued)

| Command | Action | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|----------|----------------|---|-------|---|-----------|---|---------|---|---------|----|--------|----|----------|----|--------|----|-------|----|----------|----|----------------|----|---------|----|---------|----|---------|----|--------|----|---------|----|--------|----|-----------|----|---------|----|-------|----|---------|----|--------|----|-------|----|-------------|----|------------|----|----------|----|--------|----|-------------|----|-------------|----|--------|----|----------|----|-------------|----|--------|----|----------|----|-----------|----|--------------|----|-------|----|--------|----|-------------|----|--------|----|----------------|-----------|----------------------|----|--------|
| +GCI = n | <p>Country settings - Automatically configure all registers for a particular country.</p> <table border="0"> <tr> <td>n</td> <td><u>Country</u></td> </tr> <tr> <td>0</td> <td>Japan</td> </tr> <tr> <td>9</td> <td>Australia</td> </tr> <tr> <td>A</td> <td>Austria</td> </tr> <tr> <td>F</td> <td>Belgium</td> </tr> <tr> <td>16</td> <td>Brazil</td> </tr> <tr> <td>1B</td> <td>Bulgaria</td> </tr> <tr> <td>20</td> <td>Canada</td> </tr> <tr> <td>26</td> <td>China</td> </tr> <tr> <td>27</td> <td>Columbia</td> </tr> <tr> <td>2E</td> <td>Czech Republic</td> </tr> <tr> <td>31</td> <td>Denmark</td> </tr> <tr> <td>35</td> <td>Ecuador</td> </tr> <tr> <td>3C</td> <td>Finland</td> </tr> <tr> <td>3D</td> <td>France</td> </tr> <tr> <td>42</td> <td>Germany</td> </tr> <tr> <td>46</td> <td>Greece</td> </tr> <tr> <td>50</td> <td>Hong Kong</td> </tr> <tr> <td>51</td> <td>Hungary</td> </tr> <tr> <td>53</td> <td>India</td> </tr> <tr> <td>57</td> <td>Ireland</td> </tr> <tr> <td>58</td> <td>Israel</td> </tr> <tr> <td>59</td> <td>Italy</td> </tr> <tr> <td>61</td> <td>South Korea</td> </tr> <tr> <td>69</td> <td>Luxembourg</td> </tr> <tr> <td>6C</td> <td>Malaysia</td> </tr> <tr> <td>73</td> <td>Mexico</td> </tr> <tr> <td>7B</td> <td>Netherlands</td> </tr> <tr> <td>7E</td> <td>New Zealand</td> </tr> <tr> <td>82</td> <td>Norway</td> </tr> <tr> <td>87</td> <td>Paraguay</td> </tr> <tr> <td>89</td> <td>Philippines</td> </tr> <tr> <td>8A</td> <td>Poland</td> </tr> <tr> <td>8B</td> <td>Portugal</td> </tr> <tr> <td>9C</td> <td>Singapore</td> </tr> <tr> <td>9F</td> <td>South Africa</td> </tr> <tr> <td>A0</td> <td>Spain</td> </tr> <tr> <td>A5</td> <td>Sweden</td> </tr> <tr> <td>A6</td> <td>Switzerland</td> </tr> <tr> <td>B8</td> <td>Russia</td> </tr> <tr> <td>B4</td> <td>United Kingdom</td> </tr> <tr> <td>B5</td> <td>United States</td> </tr> <tr> <td>FE</td> <td>Taiwan</td> </tr> </table> <p>Note: U-registers are configured to Silicon Laboratories' recommended values. The +GCI command resets the U-registers and the S7 and S6 S-registers to default values before setting country-specific values. Changes may be made by writing individual registers after sending the AT+GCI command.</p> | n | <u>Country</u> | 0 | Japan | 9 | Australia | A | Austria | F | Belgium | 16 | Brazil | 1B | Bulgaria | 20 | Canada | 26 | China | 27 | Columbia | 2E | Czech Republic | 31 | Denmark | 35 | Ecuador | 3C | Finland | 3D | France | 42 | Germany | 46 | Greece | 50 | Hong Kong | 51 | Hungary | 53 | India | 57 | Ireland | 58 | Israel | 59 | Italy | 61 | South Korea | 69 | Luxembourg | 6C | Malaysia | 73 | Mexico | 7B | Netherlands | 7E | New Zealand | 82 | Norway | 87 | Paraguay | 89 | Philippines | 8A | Poland | 8B | Portugal | 9C | Singapore | 9F | South Africa | A0 | Spain | A5 | Sweden | A6 | Switzerland | B8 | Russia | B4 | United Kingdom | B5 | United States | FE | Taiwan |
| n | <u>Country</u> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | Japan | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Australia | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | Austria | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F | Belgium | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16 | Brazil | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1B | Bulgaria | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | Canada | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 26 | China | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 27 | Columbia | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2E | Czech Republic | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 31 | Denmark | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 35 | Ecuador | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3C | Finland | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3D | France | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 42 | Germany | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 46 | Greece | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 50 | Hong Kong | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 51 | Hungary | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 53 | India | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 57 | Ireland | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 58 | Israel | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 59 | Italy | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 61 | South Korea | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 69 | Luxembourg | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6C | Malaysia | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 73 | Mexico | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7B | Netherlands | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7E | New Zealand | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 82 | Norway | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 87 | Paraguay | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 89 | Philippines | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8A | Poland | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8B | Portugal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9C | Singapore | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9F | South Africa | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A0 | Spain | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A5 | Sweden | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A6 | Switzerland | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B8 | Russia | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B4 | United Kingdom | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B5 | United States | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FE | Taiwan | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +GCI? | List current country code setting (response is: + GCI:<setting>) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>*Note: This command should only be issued when the Si2435/17 is off-hook.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Table 10. Basic AT Command Set (Command Defaults in Bold) (Continued)

| Command | Action |
|--|---|
| +GCI = ? | List all possible country code settings. |
| +GMI | Report manufacturer ID. "Silicon Laboratories" |
| +GMM | Report ISOmodem chipset number. <system-side> / <line-side> For example – "Si2435 / Si3018" |
| +GMR | Report ISOmodem chipset revision. <system-side rev> / <line-side rev> For example – "A / F" |
| +IFC Options +IFC = A +IFC = A,B | Specifies the flow control to be implemented. A Specifies the flow control method used by the host to control data from the modem 0 None 2 Hardware flow control (RTS) B Specifies the flow control method used by the modem to control data from the host 0 None 2 Hardware flow control (CTS). |
| +IPR = n | Select DTE rate <u>n</u> <u>Description</u> 0 Automatically detect baud rate 2400 DTE rate of 2400 bits/s 9600 DTE rate of 9600 bits/s 19200 DTE rate of 19.2 kbits/s 115200 DTE rate of 115.2 kbits/s Other DTE rates supported include: n = 300, 600, 1200, 4800, 7200, 12000, 14400, 38400, 57600, 230400, 245760, 307200 |
| +ITF Options +ITF = A +ITF = A,B +ITF = A,B,C | Transmit flow control threshold. A Threshold above which the modem will generate a flow off signal <0 to 511> bytes B Threshold below which the modem will generate a flow on signal <0 to 511> bytes C Polling interval for <BNUM> indicator 0 to 300 in 10 msec units. |
| +MR = n | Modulation reporting control. <u>n</u> <u>Mode</u> 0 Disabled 1 Enabled If enabled, the intermediate result code is transmitted at the point during connect negotiation. The format of this result code is as follows: +MCR: <carrier> e.g. +MCR: V34 +MRR: <rate> e.g. +MRR: 33600 |
| *Note: This command should only be issued when the Si2435/17 is off-hook. | |

Table 10. Basic AT Command Set (Command Defaults in Bold) (Continued)

| Command | Action |
|---|---|
| +MS Options +MS = A +MS = A,B +MS = A,B,C +MS = A,B,C,D +MS = A,B,C,D,E +MS = A,B,C,D,E,F | <p>Modulation Selection.</p> <p>To be used in conjunction with &Tn to set up loop back test modes at the appropriate modulation.</p> <p>A Preferred modem carrier</p> <p>V21 ITU-T V.21</p> <p>V22 ITU-T V.22</p> <p>V22B ITU-T V.22bis</p> <p>V32 ITU-T V.32</p> <p>V32B ITU-T V.32bis</p> <p>V34 ITU-T V.34</p> <p>B Automatic modulation negotiation</p> <p>0 Disabled</p> <p>1 Enabled</p> <p>C,D Min TX rate/Max TX rate are optional numeric values that specify the lowest value at which the DCE may establish a connection. If unspecified (set to 0), they are determined by the carrier and automode settings.</p> <p>E,F Min RX rate/Max RX rate are optional numeric values which specify the highest value at which the DCE may establish a connection. If unspecified (set to 0), they are determined by the carrier and automode settings.</p> |
| +VCDT = n | <p>Caller ID Type.</p> <p><u>n</u> <u>Mode</u></p> <p>0 After ring only</p> <p>1 Always on</p> <p>2 UK</p> <p>3 Japan</p> <p>4 DTMF after polarity reversal</p> <p>5 DTMF after polarity reversal (off-hook reception)</p> <p>6 Always on DTMF</p> <p>7 DTMF after ring</p> |
| +VCID = n | <p>Caller ID Enable.</p> <p><u>n</u> <u>Mode</u></p> <p>0 Off</p> <p>1 On—formatted</p> <p>2 On—raw data format</p> |
| +VDR = n | <p>Distinctive ring</p> <p><u>n</u> <u>Mode</u></p> <p>0 Disable distinctive ring</p> <p>1,0 Enable distinctive ring. The ISModem will report DROF and DRON result codes only. DROF and DRON are reported in 100 ms units.</p> <p>1,x Enable distinctive ring. The ISModem will report DROF and DRON result codes as well as well as a RING result code x/10 seconds after the falling edge of a ring pulse. DROF and DRON are reported in 100 ms units.</p> |
| +VIP | Load voice factory defaults |
| <p>*Note: This command should only be issued when the Si2435/17 is off-hook.</p> | |

Table 10. Basic AT Command Set (Command Defaults in Bold) (Continued)

| Command | Action |
|--|--|
| +VLS = n | Analog source / destination select <u>n</u> <u>Description</u> 0 ISModem on-hook. AOUT disabled. Tone detectors disabled. 1 ISModem off-hook. AOUT disabled. Tone detectors disabled. 4 ISModem on-hook. AOUT connected to ISModem tone generators. Tone detectors disabled. 5 ISModem off-hook. AOUT connected to PSTN. Tone detectors enabled. 20 ISModem on-hook. AOUT disabled. Tone detectors enabled. 21 ISModem on-hook. AOUT connected to ISModem tone generators. Tone detectors enabled. |
| +VNH = <hook> | Automatic hangup control <u><hook></u> <u>Hook control description</u> 0 The ISModem retains automatic hangups as is normal in the other modes (such as hanging up the phone when the ISModem does not detect a data carrier with a given time interval). 1 The ISModem shall disable automatic hangups in the other non-voice modes. 2 The ISModem shall disable all hang-ups in other non-voice modes. The ISModem shall only perform a "logical" hangup (return the OK result code). |
| +VRA = n | Ringing tone goes away timer The ISModem only uses this command in call origination transactions. This command sets the amount of time in 0.1 second units the ISModem shall wait between Ringing Tone before it can assume that the remote modem has gone off-hook. Default time is 5 seconds. |
| +VRID = n | Repeat caller ID <u>n</u> <u>Description</u> 0 Display Caller ID information of the last incoming call in formatted form. 1 Display Caller ID information of the last incoming call in unformatted form. |
| +VRN = n | Ringing tone never appeared timer This command sets the amount of time in seconds the ISModem will wait looking for Ringing Tone. If the ISModem does not detect Ringing Tone in this time period, the ISModem shall assume that the remote station has gone off-hook, and return a OK result code. Default time is 0 seconds. |
| +VSD = <sds>, <sdi> | Silence detection <u><sds></u> Noise level sensitivity 127 Less aggressive [more sensitive, lower noise levels considered to be silence]. 128 Nominal level of sensitivity. 129 More aggressive [less sensitive, higher noise levels considered to be silence]. <u><sdi></u> sets the length of a time interval in 0.1 second units, which must contain no or little activity, before the ISModem will report (QUIET) (<DLE><q>). Default is five seconds. |
| *Note: This command should only be issued when the Si2435/17 is off-hook. | |

Table 10. Basic AT Command Set (Command Defaults in Bold) (Continued)

| Command | Action |
|--|--|
| +VTD = n | DTMF / Tone duration timer This command sets the default DTMF / tone generation duration in 10 ms units for the +VTS command. Default time is 1 second (n = 100). |
| +VTS = <string> | DTMF and tone generation This command can be used to produce DTMF tones, single-frequency tones, and double-frequency tones. |
| *Note: This command should only be issued when the Si2435/17 is off-hook. | |

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Table 11. Carrier n

| n | Modulation | Train time | Rate (bps) |
|------|------------|------------|------------|
| 3 | V.21 ch 2 | — | 300 |
| 24 | V.27 ter | — | 2400 |
| 48 | V.27 ter | — | 4800 |
| 72 | V.29 | — | 7200 |
| 73 | V.17 | Long | 7200 |
| 74 | V.17 | Short | 7200 |
| 96 | V.29 | — | 9600 |
| 97 | V.17 | Long | 9600 |
| 98 | V.17 | Short | 9600 |
| 121 | V.17 | Long | 12000 |
| 122 | V.17 | Short | 12000 |
| 145 | V.17 | Long | 14400 |
| 146 | V.17 | Short | 14400 |
| FSKL | V.8 retry | — | — |

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Table 12. Result Codes¹

| Numeric | Meaning | Verbal Response | X0 | X1 | X2 | X3 | X4 | X5 |
|---------|---|--|----|----|----|----|----|----|
| 0 | Command was successful | OK | X | X | X | X | X | X |
| 1 | Link established at 300 bps or higher | CONNECT | X | X | X | X | X | X |
| 2 | Incoming ring detected | RING | X | X | X | X | X | X |
| 3 | Link dropped | NO CARRIER | X | X | X | X | X | X |
| 4 | Command failed | ERROR | X | X | X | X | X | X |
| 5 | Link establish at 1200 | CONNECT 1200 | | X | X | X | X | X |
| 6 | Dial tone not present | NO DIALTONE | | | X | | X | X |
| 7 | Line busy | BUSY | | | | X | X | X |
| 8 | Remote not answering | NO ANSWER | X | X | X | X | X | X |
| 9 | Ringback detected | RINGING | | | | | | X |
| 10 | Link established at 2400 | CONNECT 2400 | | X | X | X | X | X |
| 11 | Link established at 4800 | CONNECT 4800 | | X | X | X | X | X |
| 12 | Link established at 9600 | CONNECT 9600 | | X | X | X | X | X |
| 14 | Link established at 19200 | CONNECT 19200 ² | | X | X | X | X | X |
| 15 | Link established at 7200 | CONNECT 7200 | | X | X | X | X | X |
| 16 | Link established at 12000 | CONNECT 12000 | | X | X | X | X | X |
| 17 | Link established at 14400 | CONNECT 14400 | | X | X | X | X | X |
| 18 | Link established at 16800 | CONNECT 16800 ² | | X | X | X | X | X |
| 19 | Link established at 21600 | CONNECT 21600 ² | | X | X | X | X | X |
| 20 | Link established at 24000 | CONNECT 24000 ² | | X | X | X | X | X |
| 21 | Link established at 26400 | CONNECT 26400 ² | | X | X | X | X | X |
| 22 | Link established at 28800 | CONNECT 28800 ² | | X | X | X | X | X |
| 23 | Link established at 31200 | CONNECT 31200 ² | | X | X | X | X | X |
| 24 | Link established at 33600 | CONNECT 33600 ² | | X | X | X | X | X |
| 30 | Caller ID mark detected | CIDM | X | X | X | X | X | X |
| 31 | Hookswitch flash detected | FLASH | X | X | X | X | X | X |
| 32 | UK CID State Tone Alert Signal detected | STAS | X | X | X | X | X | X |
| 33 | Overcurrent condition | X ³ | X | X | X | X | X | X |
| 42 | No phone line present | NO LINE (enabled via %Vn commands) | X | X | X | X | X | X |
| 43 | Telephone line is in use | LINE IN USE (enabled via %Vn commands) | X | X | X | X | X | X |
| 44 | A polarity reversal was detected | POLARITY REVERSAL (enabled via G modifier) | X | X | X | X | X | X |

Notes:

1. The connect messages shown in this table are sent when link negotiation is complete.
2. This message is only supported on the Si2435.
3. X is the only verbal response code that does not follow the <CR><LF>Result Code<CR><LF> standard. There is no leading <CR><LF>.

Table 12. Result Codes¹ (Continued)

| Numeric | Meaning | Verbal Response | X0 | X1 | X2 | X3 | X4 | X5 |
|---------|---|--|----|----|----|----|----|----|
| 45 | A polarity reversal was NOT detected | NO POLARITY REVERSAL (enabled via G modifier) | X | X | X | X | X | X |
| 75 | Link established at 75 | CONNECT 75 | | X | X | X | X | X |
| 102 | DTMF dial attempted on a pulse dial only line | UN-OBTAINABLE NUMBER | X | X | X | X | X | X |

Notes:

1. The connect messages shown in this table are sent when link negotiation is complete.
2. This message is only supported on the Si2435.
3. X is the only verbal response code that does not follow the <CR><LF>Result Code<CR><LF> standard. There is no leading <CR><LF>.

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5. S-Registers

The S command allows reading (Sn?) or writing (Sn = x) the S-registers. The S-registers store values for functions that typically are rarely changed, such as timers or counters, and the ASCII values of control characters, such as carriage return. Table 13 summarizes the S-register set.

Table 13. S-Register Description

| Definition | | | | |
|----------------------|--|-------------------|-------|-------------|
| S-Register (Decimal) | Function | Default (Decimal) | Range | Units |
| 0 | Automatic answer—Number of rings the Si2435/17 must detect before answering a call. 0 disables auto answer. | 0 | 0–255 | Rings |
| 1 | Ring counter. | 0 | 0–255 | Rings |
| 2 | ESC code character. | 43 (+) | 0–255 | ASCII |
| 3 | Carriage return character. | 13 (CR) | 0–255 | ASCII |
| 4 | Linefeed character. | 10 (LF) | 0–255 | ASCII |
| 5 | Backspace character. | 08 (BS) | 0–255 | ASCII |
| 6 | Dial tone wait timer—Number of seconds the Si2435/17 waits before blind dialing. Only applicable if blind dialing is enabled (X0, X1, X3). | 02 | 0–255 | seconds |
| 7 | Carrier wait timer—Number of seconds the Si2435/17 waits for carrier before timing out. This register also sets the number of seconds the modem waits for ring-back when originating a call before hanging up. This register also sets the number of seconds the answer tone will continue while using the AT*Y2A command. | 80 | 0–255 | seconds |
| 8 | Dial pause timer for , and < dial command modifiers. | 02 | 0–255 | seconds |
| 9 | Carrier presence timer—Time after a loss of carrier that a carrier must be detected before reactivating DCD. S9 is referred to as “carrier loss debounce time.” | 06 | 1–255 | 0.1 second |
| 10 | Carrier loss timer—Time the carrier must be lost before the Si2435/17 disconnects. Setting 255 disables disconnect entirely. If S10 is less than S9, even a momentary loss of carrier causes a disconnect. | 14 | 1–255 | 0.1 second |
| 12 | Escape code guard timer—Minimum guard time required before and after “+++” for the Si2435/17 to recognize a valid escape sequence. | 50 | 1–255 | 0.02 second |
| 14 | Wait for dial tone delay value (in relation to the W dial modifier). Starts when “W” is executed in the dial string. | 12 | 0–255 | seconds |

Table 13. S-Register Description (Continued)

| Definition | | | | |
|----------------------|--|-------------------|-------|---------|
| S-Register (Decimal) | Function | Default (Decimal) | Range | Units |
| 24 | Sleep Inactivity Time—Sets the time that the modem operates in normal power mode with no activity on the serial port, parallel port, or telephone line before entering low-power sleep mode. This feature is disabled if the timer is set to 0. | 0 | 0–255 | seconds |
| 30 | Disconnect Activity Timer—Sets the length of time that the modem stays online before disconnecting with no activity on the serial port, parallel port, or telephone line (Ring, hookswitch flash, or caller ID). This feature is disabled if set to 0. | 0 | 0–255 | minutes |
| 38 | Hang Up Delay Time—Maximum delay between receipt of ATH0 command and hang up. If time out occurs before all data can be sent, the NO CARRIER (3) result code is sent (operates in V.42 mode only). “OK” response is sent if all data is transmitted before timeout. S38 = 255 disables timeout and modem disconnects only if data is successfully sent or carrier is lost. | 20 | 0–255 | seconds |
| 40 | Data Pattern—Data pattern generated during &T4 and &T5 transmit tests. 0 = All spaces (0s) 1 = All marks (1s) 2 = Random data | 0 | 0–2 | |

Table 13. S-Register Description (Continued)

| Definition | | | | | | | | | | | | | | | | |
|----------------------|--|-------------------|------------|---------|------------|------|------------|------|------------|------|------------|------|------------|---|-----|--|
| S-Register (Decimal) | Function | Default (Decimal) | Range | Units | | | | | | | | | | | | |
| 41 | <p>V.34 symbol rate - Symbol rate for V.34 when using the &T4 and &T5 commands.</p> <p>0 = 2400 symbols/second 1 = 2743 symbols/second 2 = 2800 symbols/second 3 = 3000 symbols/second 4 = 3200 symbols/second 5 = 3429 symbols/second</p> <p>A valid combination of symbol rate (S41) and data rate (&G) must be selected.</p> <p><u>Symbol Rate</u> <u>Allowable Data Rates</u></p> <table> <tr> <td>2400</td> <td>2400–21600</td> </tr> <tr> <td>2743</td> <td>4800–26400</td> </tr> <tr> <td>2800</td> <td>4800–26400</td> </tr> <tr> <td>3000</td> <td>4800–28800</td> </tr> <tr> <td>3200</td> <td>4800–31200</td> </tr> <tr> <td>3429</td> <td>4800–33600</td> </tr> </table> | 2400 | 2400–21600 | 2743 | 4800–26400 | 2800 | 4800–26400 | 3000 | 4800–28800 | 3200 | 4800–31200 | 3429 | 4800–33600 | 0 | 0–5 | |
| 2400 | 2400–21600 | | | | | | | | | | | | | | | |
| 2743 | 4800–26400 | | | | | | | | | | | | | | | |
| 2800 | 4800–26400 | | | | | | | | | | | | | | | |
| 3000 | 4800–28800 | | | | | | | | | | | | | | | |
| 3200 | 4800–31200 | | | | | | | | | | | | | | | |
| 3429 | 4800–33600 | | | | | | | | | | | | | | | |
| 50 | <p>Minimum on-hook time—Modem will remain on-hook for S50 seconds. Any attempt to go off-hook will be delayed until this timer expires.</p> | 3 | 0–255 | seconds | | | | | | | | | | | | |

6. User-Access Registers (U-Registers)

The :U AT command is used to write these 16-bit U-registers, and the :R command is used to read them. U-registers are identified by a hexadecimal (hex) address.

Table 14. U-Register Description

| Register | Name | Description | Default |
|----------|-------|--|---------|
| U00 | DT1A0 | DT1 registers set the coefficients for stage 1 of the Dial Tone Detect filter. Default is for FCC countries. | 0x0800 |
| U01 | DT1B1 | | 0x0000 |
| U02 | DT1B2 | | 0x0000 |
| U03 | DT1A2 | | 0x0000 |
| U04 | DT1A1 | | 0x0000 |
| U05 | DT2A0 | Dial tone detect filters stage 2 biquad coefficients. | 0x00A0 |
| U06 | DT2B1 | | 0x6EF1 |
| U07 | DT2B2 | | 0xC4F4 |
| U08 | DT2A2 | | 0xC000 |
| U09 | DT2A1 | | 0x0000 |
| U0A | DT3A0 | Dial tone detect filters stage 3 biquad coefficients. | 0x00A0 |
| U0B | DT3B1 | | 0x78B0 |
| U0C | DT3B2 | | 0xC305 |
| U0D | DT3A2 | | 0x4000 |
| U0E | DT3A1 | | 0xB50A |
| U0F | DT4A0 | Dial tone detect filters stage 4 biquad coefficients. | 0x0400 |
| U10 | DT4B1 | | 0x70D2 |
| U11 | DT4B2 | | 0xC830 |
| U12 | DT4A2 | | 0x4000 |
| U13 | DT4A1 | | 0x80E2 |
| U14 | DTK | Dial tone detect filter output scaler. | 0x0009 |
| U15 | DTON | Dial tone detect ON threshold. | 0x00A0 |
| U16 | DTOF | Dial tone detect OFF threshold. | 0x0070 |

Table 14. U-Register Description (Continued)

| Register | Name | Description | Default |
|----------|-------|--|---------|
| U17 | BT1A0 | BT1 registers set the coefficients for stage 1 of the Busy Tone Detect filter. Default is for FCC countries. | 0x0800 |
| U18 | BT1B1 | | 0x0000 |
| U19 | BT1B2 | | 0x0000 |
| U1A | BT1A2 | | 0x0000 |
| U1B | BT1A1 | | 0x0000 |
| U1C | BT2A0 | Busy tone detect filter stage 2 biquad coefficients. | 0x00A0 |
| U1D | BT2B1 | | 0x6EF1 |
| U1E | BT2B2 | | 0xC4F4 |
| U1F | BT2A2 | | 0xC000 |
| U20 | BT2A1 | | 0x0000 |
| U21 | BT3A0 | Busy tone detect filter stage 3 biquad coefficients. | 0x00A0 |
| U22 | BT3B1 | | 0x78B0 |
| U23 | BT3B2 | | 0xC305 |
| U24 | BT3A2 | | 0x4000 |
| U25 | BT3A1 | | 0xB50A |
| U26 | BT4A0 | Busy tone detect filter stage 4 biquad coefficients. | 0x0400 |
| U27 | BT4B1 | | 0x70D2 |
| U28 | BT4B2 | | 0xC830 |
| U29 | BT4A2 | | 0x4000 |
| U2A | BT4A1 | | 0x80E2 |
| U2B | BTK | Busy tone detect filter output scaler. | 0x0009 |
| U2C | BTON | Busy tone detect ON threshold. | 0x00A0 |
| U2D | BTOF | Busy tone detect OFF threshold. | 0x0070 |
| U2E | BMTT | Busy cadence minimum total time in seconds multiplied by 7200. | 0x0870 |
| U2F | BDLT | Busy cadence delta in seconds multiplied by 7200. | 0x25F8 |
| U30 | BMOT | Busy cadence minimum on time in seconds multiplied by 7200. | 0x0438 |
| U31 | RMTT | Ringback cadence minimum total time in seconds multiplied by 7200. | 0x4650 |
| U32 | RDLT | Ringback cadence delta in seconds multiplied by 7200. | 0xEF10 |
| U33 | RMOT | Ringback cadence minimum on time in seconds multiplied by 7200. | 0x1200 |

Table 14. U-Register Description (Continued)

| Register | Name | Description | Default |
|----------|------|---|---------|
| U34 | DTWD | Window to look for dialtone in seconds multiplied by 1000. | 0x1B58 |
| U35 | DMOT | Minimum dialtone on time in seconds multiplied by 7200. | 0x2D00 |
| U37 | PD0 | Number of pulses to dial 0. | 0x000A |
| U38 | PD1 | Number of pulses to dial 1. | 0x0001 |
| U39 | PD2 | Number of pulses to dial 2. | 0x0002 |
| U3A | PD3 | Number of pulses to dial 3. | 0x0003 |
| U3B | PD4 | Number of pulses to dial 4. | 0x0004 |
| U3C | PD5 | Number of pulses to dial 5. | 0x0005 |
| U3D | PD6 | Number of pulses to dial 6. | 0x0006 |
| U3E | PD7 | Number of pulses to dial 7. | 0x0007 |
| U3F | PD8 | Number of pulses to dial 8. | 0x0008 |
| U40 | PD9 | Number of pulses to dial 9. | 0x0009 |
| U42 | PDBT | Pulse dial break time (ms units). | 0x003D |
| U43 | PDMT | Pulse dial make time (ms units). | 0x0027 |
| U45 | PDIT | Pulse dial interdigit time (ms units). | 0x0320 |
| U46 | DTPL | DTMF power level—16-bit format is 0x0(H)(L)0 where H is the (–)dBm level of the high-frequency DTMF tone and L is the (–)dBm level of the low-frequency DTMF tone. Note that twist may be specified here. | 0x09B0 |
| U47 | DTNT | DTMF on time (ms units). | 0x0064 |
| U48 | DTFT | DTMF off time (ms units). | 0x0064 |
| U49 | RGFH | Ring frequency high—Maximum frequency ring to be considered a valid ring. RGFH = 2400/(maximum ring frequency). | 0x0022 |
| U4A | RGFD | Ring delta $RGFD = 2400 \text{ Hz} \times \left(\frac{1}{\text{min ring freq (Hz)}} \right) - \left(\frac{1}{\text{max ring freq (Hz)}} \right)$ | 0x007A |
| U4B | RGMN | Ring cadence minimum ON time in seconds multiplied by 2400. | 0x0258 |
| U4C | RGNX | Ring cadence maximum total time in seconds multiplied by 2400. | 0x6720 |
| U4D | MOD1 | This is a bit-mapped register. | 0x0000 |
| U4E | PRDD | Pre-dial delay-time after ATD command that modem waits to dial (ms units). The Si2435/17 stays on-hook during this time. | 0x0000 |

Table 14. U-Register Description (Continued)

| Register | Name | Description | Default |
|----------|-------|--|---------|
| U4F | FHT | Flash Hook Time. Time corresponding with “!” or “&” dial modifier that the Si2435/17 goes on-hook during a flash hook (ms units). | 0x01F4 |
| U50 | LCDN | Loop current debounce on time (ms units). | 0x015E |
| U51 | LCDF | Loop current debounce off time (ms units). | 0x00C8 |
| U52 | XMTL | Transmit level (1 dB units)—Sets the modem data pump transmitter level. Default level of 0 corresponds to -9.85 dBm. Transmit level = $-(9.85 + XMTL)$ dBm. Range = -9.85 to -48 . | 0x0000 |
| U62 | DAAC1 | This is a bit-mapped register. | 0x0804 |
| U63 | DAAC3 | This is a bit-mapped register. | |
| U65 | DAAC4 | This is a bit-mapped register. | 0x00E0 |
| U66 | DAAC5 | This is a bit-mapped register. | 0x0040 |
| U67 | ITC1 | This is a bit-mapped register. | 0x0008 |
| U68 | ITC2 | This is a bit-mapped register. | 0x0000 |
| U6A | ITC4 | This is a bit-mapped register. | N/A |
| U6C | LVS | This is a bit-mapped register. | 0x0000 |
| U6E | CK1 | This is a bit-mapped register. | 0x1F20 |
| U6F | PTMR | This is a bit-mapped register. | 0x00FF |
| U70 | IO0 | This is a bit-mapped register. | 0x2700 |
| U71 | IO1 | This is a bit-mapped register. | 0x0000 |
| U76 | GEN1 | This is a bit-mapped register. | 0x3240 |
| U77 | GEN2 | This is a bit-mapped register. | 0x401E |
| U78 | GEN3 | This is a bit-mapped register. | 0x0000 |
| U7A | GENA | This is a bit-mapped register. | 0x0000 |
| U7C | GENC | This is a bit-mapped register. | 0x0000 |
| U7D | GEND | This is a bit-mapped register. | 0x0000 |
| U83 | NOLN | No-Line threshold. If %V1 is set, NOLN sets the threshold for determination of line present vs. line not present. | 0x0001 |
| U84 | LIUS | Line-in-use threshold. If %V1 is set, LIUS sets the threshold for determination of line in use vs. line not in use. | 0x0007 |
| U85 | NLIU | Line-in-use/No line threshold. If %V2 is set, NLIU sets the threshold reference for the adaptive algorithm (see %V2). | 0x0000 |
| U87 | SAM | This is a bit-mapped register | 0x0000 |

Table 14. U-Register Description (Continued)

| Register | Name | Description | Default |
|----------|------|--|---------|
| U9F | SASF | SAS frequency detection. | 0x0000 |
| UA0 | SC0 | SAS cadence 0. Sets the duration of the first SAS tone (ms). | 0x01E0 |
| UA1 | SC1 | SAS cadence 1. Sets the duration of the first SAS silence (ms). | 0x0000 |
| UA2 | SC2 | SAS cadence 2. Sets the duration of the second SAS tone (ms). | 0x0000 |
| UA3 | SC3 | SAS cadence 3. Sets the duration of the second SAS silence (ms). | 0x0000 |
| UA4 | SC4 | SAS cadence 4. Sets the duration of the third SAS tone (ms). | 0x0000 |
| UA5 | SC5 | SAS cadence 5. Sets the duration of the third SAS silence (ms). | 0x0000 |
| UA6 | SC6 | SAS cadence 6. Sets the duration of the fourth SAS tone (ms). | 0x0000 |
| UA7 | SC7 | SAS cadence 7. Sets the duration of the fourth SAS silence (ms). | 0x0000 |
| UA8 | SC8 | SAS cadence 8. Sets the duration of the fifth SAS tone (ms). | 0x0000 |
| UA9 | SC9 | SAS cadence 9. Sets the duration of the fifth SAS silence (ms). | 0x0000 |

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Table 15. Bit-Mapped U-Register Summary

| Reg. | Name | Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | |
|------|-------|-----------|--------|-----------|---------|--------|--------|----------|----------|-------|-----------|----------|-------|----------|-------|-------|----------|--|
| U4D | MOD1 | | TOCT | | NHFP | NHFD | CLPD | | FTP | SPDM | | GT18 | GT55 | CTE | | | | |
| U62 | DAAC1 | | | | | | | | OHS2 | | | | | | FOH | DL | | |
| U63 | DAAC3 | LCS[7:0] | | | | | | ACT[3:0] | | | | | | | | | | |
| U65 | DAAC4 | | PWMG | PDN | | | | | | | | | PDL | | | | | |
| U66 | DAAC5 | | | | | | | | | | FDT | | | | | | | |
| U67 | ITC1 | | | MINI[1:0] | | | | ILIM | | DCR | OHS | | | DCV[1:0] | | RZ | RT | |
| U68 | ITC2 | | | | | | | | | | | | | | BTE | ROV | BTD | |
| U6A | ITC4 | | | | | | | | | | | | | | OVL | | | |
| U6C | LVS | LVS[7:0] | | | | | | | | | | | | | | | | |
| U6E | CK1 | | | | R1[4:0] | | | | | | | | | | | | | |
| U6F | PTME | | | | | | | | | | PTMR[7:0] | | | | | | | |
| U70 | IO0 | HES | | TES | CIDM | OCDM | PPDM | RIM | DCDM | | | | CID | OCD | PPD | RI | DCD | |
| U71 | IO1 | | | | | | | | | | | | COMP | | | | PRT | |
| U76 | GEN1 | OHSR[6:0] | | | | | | FACL | DCL[2:0] | | | ACL[4:0] | | | | | | |
| U77 | GEN2 | IST[3:0] | | | | HOI | | AOC | OHT[8:0] | | | | | | | | | |
| U78 | GEN3 | IB[1:0] | | | | | | | IS[7:0] | | | | | | | | | |
| U7A | GENA | | | | | | | | DOP | ADD | | | | | | | | |
| U7C | GENC | | | | | | | | | | | | RIGPO | | | | RIG-POEN | |
| U7D | GEND | | NLM | | | | | | | | | | | | | ATZD | FDP | |
| U87 | SAM | | | | | | MINT | SERM | FSMS | XMTT | | | | | | | | |

6.1. Bit-Mapped U-Register Detail (defaults in bold)

U4D MOD1

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|------|-----|------|------|------|----|-----|------|----|------|------|-----|----|----|----|
| Name | | TOCT | | NHFP | NHFD | CLPD | | FTP | SPDM | | GT18 | GT55 | CTE | | | |
| Type | R/W | | | R/W | R/W | R/W | | R/W | R/W | | R/W | R/W | R/W | | | |

Reset settings = 0x0000

| Bit | Name | Function |
|-----|----------|---|
| 15 | Reserved | Read returns zero. |
| 14 | TOCT | Turn Off Calling Tone. 0 = Disable. 1 = Enable. |
| 13 | Reserved | Read returns zero. |
| 12 | NHFP | No Hook Flash Pulse. 0 = Disable. 1 = Enable. |
| 11 | NHFD | No Hook Flash Dial. 0 = Disable. 1 = Enable. |
| 10 | CLPD | Check Loop Current Before Dialing. 0 = Ignore. 1 = Check. |
| 9 | Reserved | Read returns zero. |
| 8 | FTP | Force Tone or Pulse. 0 = Disable. 1 = Enable. |
| 7 | SPDM | Skip Pulse Dial Modifier. 0 = No. 1 = Yes. |
| 6 | Reserved | Read returns zero. |
| 5 | GT18 | 1800 Hz Guard Tone Enable. 0 = Disable. 1 = Enable. |
| 4 | GT55 | 550 Hz Guard Tone Enable. 0 = Disable. 1 = Enable. |
| 3 | CTE | Calling Tone Enable. 0 = Disable. 1 = Enable. |
| 2:0 | Reserved | Read returns zero. |



Si2435/Si2417

U62 DAAC1

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----|-----|-----|-----|----|------|----|----|----|-----|-----|-----|----|----|
| Name | 0 | 0 | 0 | 0 | 1 | 0 | 0 | OHS2 | 0 | 0 | 0 | 0 | 0 | FOH | DL | 0 |
| Type | R/W | | | | | | | | | | | R/W | R/W | | | |

Reset settings = 0x0804

| Bit | Name | Function | | | | | | | | | | | | |
|-------|----------|---|-----|------|--------------------|---|---|------------------|---|---|--------------------------------------|---|---|--|
| 15:12 | Reserved | Must be set to 0. | | | | | | | | | | | | |
| 11 | Reserved | Must be set to 1. | | | | | | | | | | | | |
| 10:9 | Reserved | Must be set to 0. | | | | | | | | | | | | |
| 8 | OHS2 | On-Hook Speed 2. This bit works in combination with the OHS bit (U67, bit 6) to set the on-hook speed. The on-hook speeds are measured from the time the OH bit is cleared until loop current equals zero. <table border="1"> <thead> <tr> <th>OHS</th> <th>OHS2</th> <th>Mean On-Hook Speed</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Less than 0.5 ms</td> </tr> <tr> <td>0</td> <td>1</td> <td>3 ms \pm10% (meets ETSI standard)</td> </tr> <tr> <td>1</td> <td>X</td> <td>26 ms \pm10% (meets Australia spark quenching spec)</td> </tr> </tbody> </table> | OHS | OHS2 | Mean On-Hook Speed | 0 | 0 | Less than 0.5 ms | 0 | 1 | 3 ms \pm 10% (meets ETSI standard) | 1 | X | 26 ms \pm 10% (meets Australia spark quenching spec) |
| OHS | OHS2 | Mean On-Hook Speed | | | | | | | | | | | | |
| 0 | 0 | Less than 0.5 ms | | | | | | | | | | | | |
| 0 | 1 | 3 ms \pm 10% (meets ETSI standard) | | | | | | | | | | | | |
| 1 | X | 26 ms \pm 10% (meets Australia spark quenching spec) | | | | | | | | | | | | |
| 7:3 | Reserved | Must be set to 0. | | | | | | | | | | | | |
| 2 | FOH | Fast Off-Hook. 0 = Automatic Calibration Time set to 426 ms. 1 = Automatic Calibration Time set to 106 ms. | | | | | | | | | | | | |
| 1 | DL | Isolation Digital Loopback (see the AT&T commands). 0 = Loopback occurs beyond the DAA interface, out to and including the analog hybrid circuit. 1 = Enables digital loopback mode across isolation barrier only. | | | | | | | | | | | | |
| 0 | Reserved | Must be set to 0. | | | | | | | | | | | | |

U63 DAAC3

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|----------|-----|-----|-----|-----|-----|----|----------|----|----|----|----|----|----|----|----|
| Name | LCS[7:0] | | | | | | | ACT[3:0] | | | | | | | | |
| Type | R/W | | | | | | | | | | | | | | | |

Reset settings = 0x0003

| Bit | Name | Function |
|------|----------|--|
| 15:8 | LCS[7:0] | Off-Hook Loop Current (1.1 mA/bit). |
| 7:4 | ACT[3:0] | AC Termination Select. ACT[3:0] AC Termination 0000 Real 600 Ω 0011 220 Ω + (820 Ω 120 nF) and 220 Ω + (820 Ω 115 nF) 0100 370 Ω + (620 Ω 310 nF) 1111 Global complex impedance |
| 3:0 | Reserved | Read returns 0x3. |

U65 DAAC4

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|------|-----|-----|-----|-----|----|----|----|----|----|-----|----|----|----|----|
| Name | | PWMG | PDN | | | | | | | | | PDL | | | | |
| Type | | R/W | R/W | | | | | | | | | R/W | | | | |

Reset settings = 0x00E0

| Bit | Name | Function |
|------|----------|---|
| 15 | Reserved | Read returns zero. |
| 14 | PWMG | PWM Gain. 0 = No gain. 1 = 6 dB gain applied to AOUT. |
| 13 | PDN | Powerdown. Completely powerdown the Si2435/17 and Si3018. Once set to 1, the Si2435/17 must be reset to power on. 0 = Normal. 1 = Powerdown. |
| 12:8 | Reserved | Read returns zero. |
| 7:5 | Reserved | Must not change in a read-modify-write. |
| 4 | PDL* | Powerdown Line-Side Chip. 0 = Normal operation. 1 = Places the Si3018 in powerdown mode. |
| 3:0 | Reserved | Must not change in a read-modify-write. |

*Note: Typically used only for board-level debug.

Si2435/Si2417

U66 DAAC5

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----|-----|-----|-----|----|----|----|-----|----|----|----|----|----|----|
| Name | | | | | | | | | | FDT | | | | | | |
| Type | R | | | | | | | | | | | | | | | |

Reset settings = 0x0040

| Bit | Name | Function |
|------|----------|---|
| 15:7 | Reserved | Read returns zero. |
| 6 | FDT* | Frame Detect. 0 = Indicates ISModem has not established frame lock. 1 = Indicates ISModem frame lock has been established. |
| 5:4 | Reserved | Read returns zero. |
| 3:0 | Reserved | Do not modify. |

***Note:** Typically used only for board-level debug.

U67 ITC1

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----------|-----|-----|-----|------|-----|-----|-----|-----|----|----------|-----|-----|-----|
| Name | | | MINI[1:0] | | | | ILIM | | DCR | OHS | | | DCV[1:0] | | RZ | RT |
| Type | R/W | | | R/W | | | R/W | R/W | R/W | R/W | R/W | | R/W | R/W | R/W | R/W |

Reset settings = 0x0008

| Bit | Name | Function | | | | | | | | | | | | |
|-----------|------------------|--|-----------|------------------|--------------------|-------|----|------------------|-----------|---------------|--------------------------------------|-------|---|--|
| 15:14 | Reserved | Read returns zero. | | | | | | | | | | | | |
| 13:12 | MINI[1:0] | <p>Minimum Operational Loop Current. Adjusts the minimum loop current at which the DAA can operate. Increasing the minimum operational loop current can improve signal headroom at a lower TIP/RING voltage.</p> <table border="1"> <thead> <tr> <th>MINI[1:0]</th> <th>Min Loop Current</th> </tr> </thead> <tbody> <tr> <td>00</td> <td>10 mA</td> </tr> <tr> <td>01</td> <td>12 mA</td> </tr> <tr> <td>10</td> <td>14 mA</td> </tr> <tr> <td>11</td> <td>16 mA</td> </tr> </tbody> </table> | MINI[1:0] | Min Loop Current | 00 | 10 mA | 01 | 12 mA | 10 | 14 mA | 11 | 16 mA | | |
| MINI[1:0] | Min Loop Current | | | | | | | | | | | | | |
| 00 | 10 mA | | | | | | | | | | | | | |
| 01 | 12 mA | | | | | | | | | | | | | |
| 10 | 14 mA | | | | | | | | | | | | | |
| 11 | 16 mA | | | | | | | | | | | | | |
| 11:10 | Reserved | Read returns zero | | | | | | | | | | | | |
| 9 | ILIM | <p>Current Limiting Enable. 0 = Current limiting mode disabled. 1 = Current limiting mode enabled. This mode limits loop current to a maximum of 60 mA per the TBR21 standard.</p> | | | | | | | | | | | | |
| 8 | Reserved | Read returns zero. | | | | | | | | | | | | |
| 7 | DCR | <p>DC Impedance Selection. 0 = Normal dc impedance. This mode should be used for all standard applications. 1 = 800 Ω dc termination.</p> | | | | | | | | | | | | |
| 6 | OHS | <p>On-Hook Speed. This bit works in combination with the OHS2 bit (U62, bit 8) to set the on-hook speed. The on-hook speeds are measured from the time the OH bit is cleared until loop current equals zero.</p> <table border="1"> <thead> <tr> <th>OHS</th> <th>OHS2</th> <th>Mean On-Hook Speed</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Less than 0.5 ms</td> </tr> <tr> <td>0</td> <td>1</td> <td>3 ms \pm10% (meets ETSI standard)</td> </tr> <tr> <td>1</td> <td>X</td> <td>26 ms \pm10% (meets Australia spark quenching spec)</td> </tr> </tbody> </table> | OHS | OHS2 | Mean On-Hook Speed | 0 | 0 | Less than 0.5 ms | 0 | 1 | 3 ms \pm 10% (meets ETSI standard) | 1 | X | 26 ms \pm 10% (meets Australia spark quenching spec) |
| OHS | OHS2 | Mean On-Hook Speed | | | | | | | | | | | | |
| 0 | 0 | Less than 0.5 ms | | | | | | | | | | | | |
| 0 | 1 | 3 ms \pm 10% (meets ETSI standard) | | | | | | | | | | | | |
| 1 | X | 26 ms \pm 10% (meets Australia spark quenching spec) | | | | | | | | | | | | |
| 5:4 | Reserved | Read returns zero. | | | | | | | | | | | | |
| 3:2 | DCV[1:0] | <p>TIP/RING Voltage Adjust. These bits adjust the voltage on the DCT pin of the line-side device, which affects the TIP/RING voltage on the line. Low voltage countries should use a lower TIP/RING voltage. Raising the TIP/RING voltage can improve signal headroom.</p> <table border="1"> <thead> <tr> <th>DCV[1:0]</th> <th>DCT Pin Voltage</th> </tr> </thead> <tbody> <tr> <td>00</td> <td>3.1 V</td> </tr> <tr> <td>01</td> <td>3.2 V</td> </tr> <tr> <td>10</td> <td>3.35 V</td> </tr> <tr> <td>11</td> <td>3.5 V</td> </tr> </tbody> </table> | DCV[1:0] | DCT Pin Voltage | 00 | 3.1 V | 01 | 3.2 V | 10 | 3.35 V | 11 | 3.5 V | | |
| DCV[1:0] | DCT Pin Voltage | | | | | | | | | | | | | |
| 00 | 3.1 V | | | | | | | | | | | | | |
| 01 | 3.2 V | | | | | | | | | | | | | |
| 10 | 3.35 V | | | | | | | | | | | | | |
| 11 | 3.5 V | | | | | | | | | | | | | |

Si2435/Si2417

| Bit | Name | Function |
|-----|------|---|
| 1 | RZ | Ringer Impedance. 0 = Maximum (high) ringer impedance. 1 = Synthesize ringer impedance. C15, R14, Z2, and Z3 must not be installed when setting this bit. |
| 0 | RT | Ringer Threshold Select. Used to satisfy country requirements on ring detection. Signals below the lower level does not generate a ring detection; signals above the upper level are guaranteed to generate a ring detection. 0 = 11 to 22 V_{rms}. 1 = 17 to 33 V_{rms}. |

U68 ITC2

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|-----|-----|-----|
| Name | | | | | | | | | | | | | | BTE | ROV | BTD |
| Type | | | | | | | | | | | | | | R/W | R/W | R/W |

Reset settings = 0x0000

| Bit | Name | Function |
|------|----------|--|
| 15:3 | Reserved | Do not modify. |
| 2 | BTE | Billing Tone Protect Enable. 0 = Disabled. 1 = Enabled. When set, the DAA responds automatically to a collapse of the line-derived power supply during a billing tone event. When off-hook, if BTE = 1 and BTD goes high, the dc termination is released (800 Ω presented to line). If BTE and RIM (U70, bit 9) are set, an RI (U70, bit 1) interrupt also occurs when BTD goes high. |
| 1 | ROV | Receive Overload. The bit is set when the receive input (i.e., receive pin goes below ground) has an excessive input level. This bit is cleared by writing a 0 to this location. 0 = Normal receive input level. 1 = Excessive receive input level. |
| 0 | BTD | Billing Tone Detected. This bit is set if a billing tone is detected. This bit is cleared by writing a 0 to this location. 0 = No billing tone. 1 = Billing tone detected. |

U6A ITC4

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|-----|----|----|
| Name | | | | | | | | | | | | | | OVL | | |
| Type | R | | | | | | | | | | | | | | | |

Reset settings = N/A

| Bit | Name | Function |
|------|----------|---|
| 15:3 | Reserved | Read returns zero. |
| 2 | OVL | Overload Detected. This bit has the same function as ROV, but clears itself after the overload has been removed. This bit is not affected by the BTE bit. |
| 1:0 | Reserved | Do not modify. |

U6C LVS

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|----------|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
| Name | LVS[7:0] | | | | | | | | | | | | | | | |
| Type | R | | | | | | | | | | | | | | | |

Reset settings = 0x0000

| Bit | Name | Function |
|------|----------|---|
| 15:8 | LVS[7:0] | Line Voltage Status. Eight bit signed, twos complement number representing the tip-ring voltage. Each bit represents 1 V. Polarity of the voltage is represented by the MSB (sign bit). 0000_0000 = Measured voltage is < 3 V. |
| 7:0 | Reserved | Read returns zero. |

Si2435/Si2417

U6E CK1

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----|---------|-----|-----|----|----|----|----|----|----|----|----|----|----|
| Name | | | | R1[4:0] | | | | | | | | | | | | |
| Type | R/W | | | | | | | | | | | | | | | |

Reset settings = 0x1F20

| Bit | Name | Function |
|-------|----------|---------------------------|
| 15:13 | Reserved | Do not modify. |
| 12:8 | R1[4:0] | R1 CLKOUT Divider. |
| 7:0 | Reserved | Read returns zero. |

U6F PTMR

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----|-----|-----|-----|----|----|----|----|----|-----------|----|----|----|----|
| Name | | | | | | | | | | | | PTMR[7:0] | | | | |
| Type | R/W | | | | | | | | | | | | | | | |

Reset settings = 0x00FF

| Bit | Name | Function |
|------|-----------|--|
| 15:8 | Reserved | Do not modify |
| 7:0 | PTMR[7:0] | Parallel Port Receive FIFO Interrupt Timer. |

U70 IO0

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----|------|------|------|-----|------|----|----|----|-----|-----|-----|-----|-----|
| Name | HES | | TES | CIDM | OCDM | PPDM | RIM | DCDM | 0 | | | CID | OCD | PPD | RI | DCD |
| Type | R/W | | R/W | R/W | R/W | R/W | R/W | R/W | | | | R/W | R/W | R/W | R/W | R/W |

Reset settings = 0x2700

| Bit | Name | Function |
|-----|----------|---|
| 15 | HES | Hardware Escape Pin. 0 = Disable. 1 = Enable. |
| 14 | Reserved | Read returns zero. |
| 13 | TES | Enable “+++” Escape. 0 = Disable. 1 = Enable. |
| 12 | CIDM | Caller ID Mask. 0 = Change in CID will not affect INT. 1 = A low to high transition in CID activates $\overline{\text{INT}}$. |
| 11 | OCDM | Overcurrent Detect Mask. 0 = Change in OCD does not affect INT. (“X” result code is not generated in command mode.) 1 = A low to high transition in OCD will activate INT. (“X” result code is generated in command mode.) |
| 10 | PPDM | Parallel Phone Detect Mask. 0 = Change in PPD does not affect $\overline{\text{INT}}$. 1 = A low to high transition in PPD will activate INT. |
| 9 | RIM | Ring Indicator. 0 = Change in RI does not affect $\overline{\text{INT}}$. 1 = A low to high transition in RI activates INT. |
| 8 | DCDM | Data Carrier Detect Mask. 0 = Change in DCD does not affect $\overline{\text{INT}}$. 1 = A high to low transition in DCD (U70, bit 0), which indicates loss of carrier, activates INT. |
| 7 | Reserved | Must be set to zero. |
| 6:5 | Reserved | Read returns zero. |
| 4 | CID | Caller ID (sticky). Caller ID preamble has been detected; data will soon follow. Clears on :I read. |
| 3 | OCD | Overcurrent Detect (sticky). Overcurrent condition has occurred. Clears on :I read. |
| 2 | PPD | Parallel Phone Detect (sticky). Parallel phone detected since last off-hook event. Clears on :I read. |
| 1 | RI | Ring Indicator. Active high bit when the Si2435/17 is on-hook, indicates ring event has occurred. Clears on :I read. |
| 0 | DCD | Data Carrier Detect (status). Active high bit indicates carrier detected (equivalent to inverse of $\overline{\text{DCD}}$ pin). |

Si2435/Si2417

U71 IO1

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----|-----|-----|-----|----|----|----|----|----|------|----|----|----|-----|
| Name | | | | | | | | | | | | COMP | | | | PRT |
| Type | | | | | | | | | | | | R/W | | | | R/W |

Reset settings = 0x0000

| Bit | Name | Function |
|------|----------|--|
| 15:5 | Reserved | Read returns zero. |
| 4 | COMP | 0 = Disables compression (PCM mode). 1 = Enables linear compression. |
| 3:1 | Reserved | Read returns zero. |
| 0 | PRT | 0 = Disables PCM mode. 1 = Enables PCM mode. |

U76 GEN1

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----------|-----|-----|-----|-----|-----|------|----------|----|----|----------|----|----|----|----|----|
| Name | OHSR[6:0] | | | | | | FACL | DCL[2:0] | | | ACL[4:0] | | | | | |
| Type | R/W | | | | | | | R/W | | | R/W | | | | | |

Reset settings = 0x3240

| Bit | Name | Function |
|------|-----------|---|
| 15:9 | OHSR[6:0] | Off-Hook Sample Rate (40 ms units). Sets the sample rate for the off-hook intrusion algorithms (1 second default). |
| 8 | FACL | Force ACL. 0 = While off-hook, ACL is automatically updated with LCS. 1 = While off-hook, ACL does not change from the value written to it while on-hook. |
| 7:5 | DCL[2:0] | Differential Current Level (3 mA units). Sets the differential level between ACL and LCS that will trigger an off-hook PPD interrupt (default = 2). |
| 4:0 | ACL[4:0] | Absolute Current Level (3 mA units). ACL represents the value of LCS current when the ISOmodem® is off-hook and all parallel phones are on-hook. If ACL = 0, it is ignored by the off-hook intrusion algorithm. The ISOmodem will also write ACL with the contents of LCS before an intrusion and before going on-hook (default = 0). |

U77 GEN2

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|----------|-----|-----|-----|-----|-----|-----|----------|-----|----|----|----|----|----|----|----|
| Name | IST[3:0] | | | | HOI | | AOC | OHT[8:0] | | | | | | | | |
| Type | R/W | | | | R/W | | R/W | | R/W | | | | | | | |

Reset settings = 0x401E

| Bit | Name | Function |
|-------|----------|---|
| 15:12 | IST[3:0] | Intrusion Settling Time (250 ms units). Delay between when the ISModem goes off-hook and the off-hook intrusion algorithm begins. Default is 1 s. |
| 11 | HOI | Hang-Up On Intrusion. 0 = ISModem will not automatically hang up when an off-hook PPD interrupt occurs. 1 = ISModem automatically hangs up on a PPD interrupt. If %Vn commands are set, HOI also causes the "LINE IN USE" result code upon PPD interrupt. |
| 10 | Reserved | Read returns zero. |
| 9 | AOC | Auto Overcurrent. 0 = Disable. 1 = Enable. Note: AOC may falsely detect an overcurrent condition in the presence of line reversals or other transients. Therefore, this feature should not be used in applications or locations (such as Japan) where line reversals are common or may be expected. |
| 8:0 | OHT[8:0] | Off-Hook Time (1 ms units). Time before LCS is checked for overcurrent condition after going off-hook (30 ms default). |

Si2435/Si2417

U78 GEN3

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|---------|-----|-----|-----|-----|-----|----|----|----|----|-----|---------|----|----|----|----|
| Name | IB[1:0] | | | | | | | | | | | IS[7:0] | | | | |
| Type | R/W | | | | | | | | | | R/W | | | | | |

Reset settings = 0x0000

| Bit | Name | Function |
|-------|----------|---|
| 15:14 | IB[1:0] | <p>Intrusion Blocking. Defines the method used to block the off-hook intrusion algorithm from operation after dialing has begun.</p> <p>0 = No intrusion blocking. 1 = Intrusion disabled from start of dial to end of dial. 2 = Intrusion disabled from start of dial to IS register time-out. 3 = Intrusion disabled from start of dial to connect (“CONNECT XXX”, “NO DIALTONE”, or “NO CARRIER”).</p> |
| 13:8 | Reserved | Read returns zero. |
| 7:0 | IS[7:0] | <p>Intrusion Suspend (500 ms units). When IB = 2, this register sets the length of time from when dialing begins that the off-hook intrusion algorithm is blocked (suspended) (default = 00000000_b).</p> |

U7A GENA

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----|-----|-----|-----|----|----|-----|-----|----|----|----|----|----|----|
| Name | | | | | | | | | DOP | ADD | | | | | | |
| Type | | | | | | | | | R/W | R/W | | | | | | |

Reset settings = 0x0000

| Bit | Name | Function |
|------|----------|--|
| 15:8 | Reserved | Read returns to zero. |
| 7 | DOP | Dial or Pulse. 0 = Normal ATDTW operation 1 = Use ATDTW for Pulse/Tone Dial Detection (see also ATDW command) |
| 6 | ADD | Adaptive Dialing 1 = Enable 0 = Disable Attempt DTMF dial, then fall back to pulse dialing if unsuccessful. First digit is dialed as DTMF. If a dialtone is still present after two seconds, the Si2435/17 will redial the first digit and remaining digits as pulse. If a dialtone is not present after two seconds, the Si2435/17 will dial the remaining digits as DTMF. |
| 5:0 | Reserved | Read returns to zero. |

Confidential

Si2435/Si2417

U7C GENC

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----|-----|-----|-----|----|----|----|----|----|-------|----|----|----|----------|
| Name | | | | | | | | | | | | RIGPO | | | | RIGPIOEN |
| Type | R | | | | | | | | | | | R/W | | | | |

Reset settings = 0x0000

| Bit | Name | Function |
|------|----------|---|
| 15:5 | Reserved | Reads returns to zero. |
| 4 | RIGPO | \overline{RI} \overline{RI} (Pin 17), follows this bit when RIGPIOEN = 1 _b . |
| 3:1 | Reserved | Reads returns to zero. |
| 0 | RIGPIOEN | 0 = \overline{RI} indicates valid ring signal. (Normal ring-indicator mode) 1 = \overline{RI} (Pin 17) can be used as a general purpose output and follows U7C[4] (RIGPO). |

U7D GEND

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|------|-----|
| Name | | NLM | | | | | | | | | | | | | ATZD | FDP |
| Type | R/W | | | | | | | | | | | | | | R/W | R/W |

Reset settings = 0x0000

| Bit | Name | Function |
|------|----------|---|
| 15 | Reserved | Reads returns to zero. |
| 14 | NLM | 0 = Enables “No Loop Current” detect. 1 = Disables “No Loop Current” detect. |
| 13:2 | Reserved | Reads returns to zero. |
| 1 | ATZD | ATZ Disable. 0 = ATZ functions normally. 1 = Disable ATZ command. |
| 0 | FDP | FSK Data Processing. 0 = FSK data processing stops when carrier is lost. 1 = FSK data processing continued for 2 bytes after carrier is lost. |

U87 SAM

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----|-----|-----|------|------|------|-----------|----|----|----|----|----|----|----|
| Name | | | | | | MINT | SERM | FSMS | XMTT[7:0] | | | | | | | |
| Type | R/W | | | | | | R/W | R/W | R/W | | | | | | | |

Reset settings = 0x0000

| Bit | Name | Function |
|-------|----------|---|
| 15:11 | Reserved | Reads returns to zero. |
| 10 | MINT | <p>Minimal Transparency</p> <p>0 = Generates two-byte transparency sequences. This option will use codes <T5> through <T20>, if possible, for received data containing two back-to-back bytes requiring transparency.</p> <p>1 = Generates one-byte transparency sequences. This option will only use codes <T1> through <T4> for received data.</p> |
| 9 | SERM | <p>Special Error Reporting Mode</p> <p>0 = Ignore unrecognized in-band commands.</p> <p>1 = Generate <0x45> ("E" for error) in response to any unrecognized in-band commands.</p> |
| 8 | FSMS | <p>Framed Sub-Mode Startup</p> <p>0 = Upon successful connection, enter Transport Sub-Mode. An <FLAG> is required to enter Framed Sub-Mode.</p> <p>1 = Upon successful connection, immediately enter Framed Sub-Mode. The first received <err> from a successful hunt is transformed into an <flag>.</p> |
| 7:0 | XMTT | <p>Transmitter Threshold</p> <p>This value represents the number of bytes before a transmission is started.</p> <p>The following values are special:</p> <p>0 The same as ten. Upon receipt of ten bytes, data is transferred. The DTE must supply a closing flag within the required time or an underrun will occur.</p> <p>255 The same as infinity, e.g. never start a packet until the closing flag is received.</p> |

7. Parallel Interface Registers

Parallel Interface 0 (0x00)

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|------------|----|----|----|----|----|----|----|
| Name | TX/RX[7:0] | | | | | | | |
| Type | R/W | | | | | | | |

Reset settings = 0x00

| Bit | Name | Function |
|-----|------------|---|
| 7:0 | TX/RX[7:0] | Parallel Interface Transmit/Receive. This register functions similarly to the serial port TX pin on writes to the parallel port, and similarly to the serial port RX pin on reads from the parallel port. |

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Parallel Interface 1 (0x01)

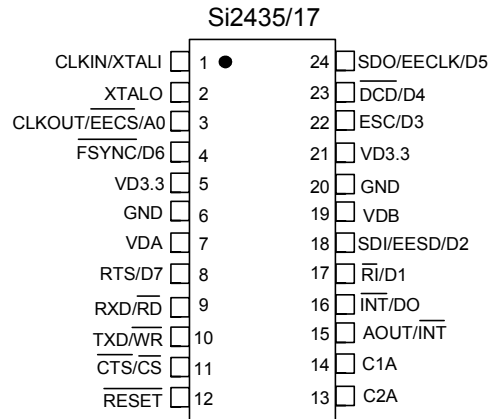
| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----|------|-----|-----|-------------------------|-------------------------|
| Name | RXF | TXE | REM | INTM | INT | ESC | $\overline{\text{RTS}}$ | $\overline{\text{CTS}}$ |
| Type | R | R | R | R/W | R | R/W | R/W | R |

Reset settings = 0110_0011

| Bit | Name | Function |
|-----|-------------------------|--|
| 7 | RXF | <p>Receive FIFO Almost Full (status).</p> <p>0 = Receive FIFO (12 deep) contains three or more empty locations ($\text{RXF} \leq 9$). The host can clear the RXF interrupt without emptying the RX FIFO by writing a 0 to the RXF bit. This will disable the RXF interrupt until the host has emptied the FIFO.</p> <p>1 = Receive FIFO contains two or less empty locations ($\text{RXF} \geq 10$).</p> |
| 6 | TXE | <p>Transmit FIFO Almost Empty (status).</p> <p>0 = Transmit FIFO (14 deep) contains three or more characters ($\text{TXF} \geq 3$).</p> <p>1 = Transmit FIFO contains two or less characters ($\text{TXF} \leq 2$).</p> <p>Note: TXE interrupt will not trigger if the CTS bit is inactive. Therefore, the host does not need to poll CTS while waiting for transmit FIFO to empty. TXE can be cleared by writing it to 0.</p> |
| 5 | REM | <p>Receive FIFO Empty.</p> <p>0 = Receive FIFO has valid data.</p> <p>1 = Receive FIFO empty.</p> <p>Note: If the interim timer (see PTMR - U6F, bits 7:0) set by PTMR expires, it will cause an interrupt. This interrupt will not set RXF, TXE, or INT. The interrupt handler on the host should then verify that $\text{REM} = 0$ and begin to empty the receive FIFO (Parallel Interface 0 register) until $\text{REM} = 1$.</p> |
| 4 | INTM | <p>Interrupt Mask.</p> <p>0 = In parallel mode, the $\overline{\text{INT}}$ pin is triggered by a rising edge on RXF or TXE only (default).</p> <p>1 = In parallel mode, the $\overline{\text{INT}}$ pin is triggered by a rising edge on RXF, TXE, or INT.</p> |
| 3 | INT | <p>Interrupt.</p> <p>0 = No interrupt has occurred.</p> <p>1 = Indicates that an interrupt (CID, OCD, PPD, RI, or DCD from U70) has occurred. This bit is cleared via the AT:I command.</p> |
| 2 | ESC | <p>Escape.</p> <p>Operation of this bit in parallel mode is functionally equivalent to the ESC pin in serial mode.</p> |
| 1 | $\overline{\text{RTS}}$ | <p>Request-to-Send.</p> <p>Operation of this bit in parallel mode is functionally equivalent to the $\overline{\text{RTS}}$ pin in serial mode. Use of the $\overline{\text{CTS}}$ and $\overline{\text{RTS}}$ bits (as opposed to the TXE and RXF bits) allows the flow control between the host and the ISModem® to operate 1 byte at a time, rather than in blocks.</p> |
| 0 | $\overline{\text{CTS}}$ | <p>Clear-to-Send.</p> <p>Operation of this bit in parallel mode is functionally equivalent to the $\overline{\text{CTS}}$ pin in serial mode. Use of the $\overline{\text{CTS}}$ and $\overline{\text{RTS}}$ bits (as opposed to the TXE and RXF bits) allows the flow control between the host and the ISModem to operate 1 byte at a time, rather than in blocks.</p> |

Si2435/Si2417

8. Pin Descriptions: Si2435/17



| Pin # | Pin Name | Description |
|-------|-------------|--|
| 1 | CLKIN/XTALI | Clock Input/Crystal Oscillator Pin. This pin provides support for parallel-resonant, AT cut crystals. XTALI also acts as an input in the event that an external clock source is used in place of a crystal. A 4.9152 MHz crystal or 4.9152/27 MHz clock is required. |
| 2 | XTALO | Crystal Oscillator Pin. This pin provides support for parallel-resonant AT-cut crystals. XTALO serves as the output of the crystal amplifier. |
| 3 | CLKOUT/A0 | Clock Output/Address Bit 0. Clock output in serial mode. Address Enable in parallel mode. |
| 4 | FSYNC/D6 | Frame Sync/Data Bit. Frame Sync output to codec in serial mode. Bidirectional parallel bus data bit 6 in parallel mode. |
| 5, 21 | VD3.3 | Digital Supply Voltage. Provides the 3.3 V digital supply voltage to the Si2435/17. |
| 6, 20 | GND | Ground. Connects to the system digital ground. |
| 7, 19 | VDA, VDB | Digital Rail. Pin provides additional power supply voltage to the Si2435/17. |
| 8 | RTS/D7 | Request-to-Send/Data Bit. Request-to-send (for flow control) in serial mode. Bidirectional parallel bus data bit 7 in parallel mode. |
| 9 | RXD/RD | Receive Data/Read Enable. Data output to DTE RXD pin in serial mode. Active low read enable pin in parallel mode. |

| Pin # | Pin Name | Description |
|-------|--|---|
| 10 | TXD/ $\overline{\text{WR}}$ | Transmit Data/Write Enable. Data input from DTE TXD pin in serial mode. Active low write enable pin in parallel mode. |
| 11 | $\overline{\text{CTS}}/\overline{\text{CS}}$ | Clear-to-Send/Chip Select. Active low clear-to-send (for flow control) in serial mode. Active low chip select in parallel mode. |
| 12 | $\overline{\text{RESET}}$ | Reset Input. An active low input that is used to reset all control registers to a defined initialized state. |
| 13 | C2A | Isolation Capacitor 2A. Connects to one side of the isolation capacitor, C2. |
| 14 | C1A | Isolation Capacitor 1A. Connects to one side of the isolation capacitor, C1. |
| 15 | AOUT/ $\overline{\text{INT}}$ | Analog Output/Interrupt Output. Analog output in serial mode. Active low interrupt output in parallel mode. |
| 16 | $\overline{\text{INT}}/\text{D0}$ | Interrupt Output/Data Bit. Active low interrupt output in serial mode. Bidirectional parallel bus data bit 0 in parallel mode. |
| 17 | $\overline{\text{RI}}/\text{D1}$ | Ring Indicator/Data Bit. The $\overline{\text{RI}}$ on (active low) indicates the presence of an ON segment of a ring signal on the telephone line. Bidirectional parallel bus data bit 1 in parallel mode. |
| 18 | SDI/D2 | Serial Data In/Data Bit. Serial Data In (to codec) output in serial mode. Bidirectional parallel bus data bit 2 in parallel mode. |
| 22 | ESC/D3 | Escape/Data Bit. Hardware escape in serial mode. Bidirectional parallel bus data bit 3 in parallel mode. |
| 23 | $\overline{\text{DCD}}/\text{D4}$ | Carrier Detect/Data Bit. Active low carrier detect in serial mode. Bidirectional parallel bus data bit 4 in parallel mode. |
| 24 | SDO/D5 | Serial Data Out/Data Bit 5. Serial Data Out (from codec) input in serial mode. Bidirectional parallel bus data bit 5 in parallel mode. |

9. Pin Descriptions: Si3018

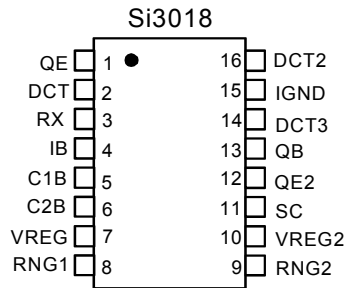


Table 16. Si3018 Pin Descriptions

| Pin # | Pin Name | Description |
|-------|----------|---|
| 1 | QE | Transistor Emitter. Connects to the emitter of Q3. |
| 2 | DCT | DC Termination. Provides dc termination to the telephone network. |
| 3 | RX | Receive Input. Serves as the receive side input from the telephone network. |
| 4 | IB | Internal Bias. Provides a bias voltage to the device. |
| 5 | C1B | Isolation Capacitor 1B. Connects to one side of isolation capacitor C1 and communicates with the Si2435/17. |
| 6 | C2B | Isolation Capacitor 2B. Connects to one side of isolation capacitor C2 and communicates with the Si2435/17. |
| 7 | VREG | Voltage Regulator. Connects to an external capacitor to provide bypassing for an internal power supply. |
| 8 | RNG1 | Ring 1. Connects through a resistor to the RING lead of the telephone line. Provides the ring and caller ID signals to the Si2435/17. |
| 9 | RNG2 | Ring 2. Connects through a resistor to the TIP lead of the telephone line. Provides the ring and caller ID signals to the Si2435/17. |
| 10 | VREG2 | Voltage Regulator 2. Connects to an external capacitor to provide bypassing for an internal power supply. |
| 11 | SC | SC Connection. Enables external transistor network. Should be tied through a 0 Ω resistor to I _{GND} . |
| 12 | QE2 | Transistor Emitter 2. Connects to the emitter of Q4. |
| 13 | QB | Transistor Base. Connects to the base of transistor Q4. |
| 14 | DCT3 | DC Termination 3. Provides the dc termination to the telephone network. |
| 15 | IGND | Isolated Ground. Connects to ground on the line-side interface. |
| 16 | DCT2 | DC Termination 2. Provides dc termination to the telephone network. |

10. Ordering Guide^{1,2}

| System Side | | | |
|--|----------|-----------|------------|
| Part Number | Package | Lead-Free | Temp Range |
| Si2435-X-FT | TSSOP-24 | Yes | 0 to 70 °C |
| Si2417-X-FT | TSSOP-24 | Yes | 0 to 70 °C |
| Line Side | | | |
| Part Number | Package | Lead-Free | Temp Range |
| Si3018-X-FS | SOIC-16 | Yes | 0 to 70 °C |
| Notes: | | | |
| 1. "X" denotes product revision. | | | |
| 2. Add an "R" at the end of the device to denote tape and reel option; 2500 quantity per reel. | | | |

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11. Package Outline: 24-Pin TSSOP

Figure 5 illustrates the package details for the Si2435/17. Table 17 lists the values for the dimensions shown in the illustration.

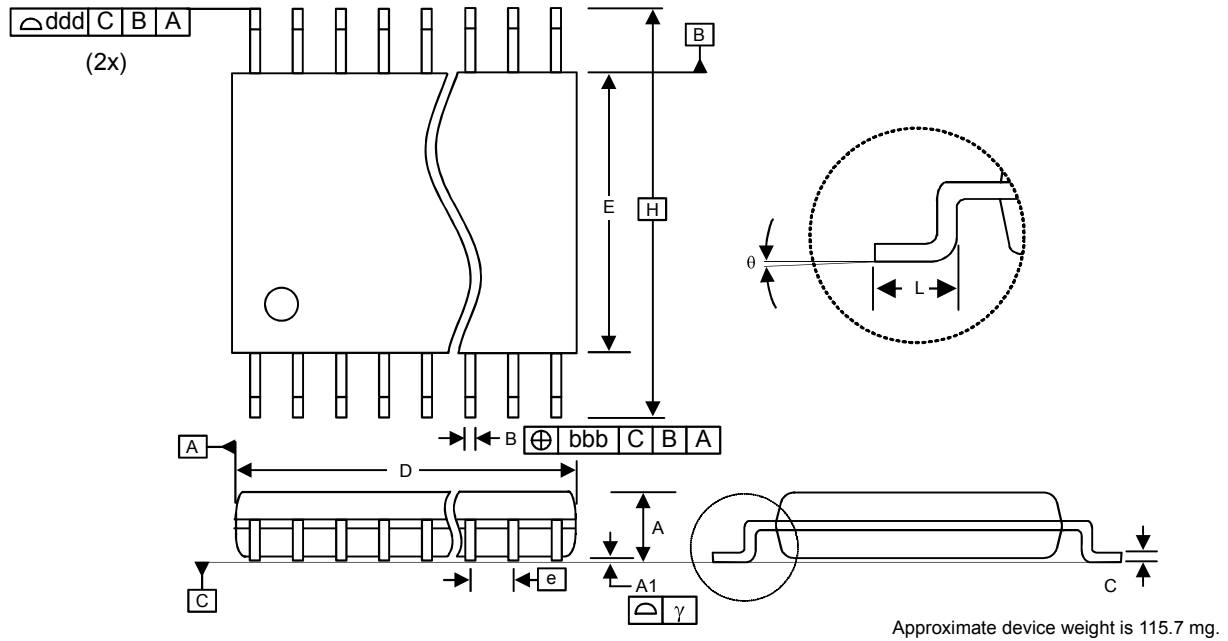


Figure 5. 24-Pin Thin Shrink Small Outline Package (TSSOP)

Table 17. Package Diagram Dimensions

| Symbol | Millimeters | |
|----------|-------------|------|
| | Min | Max |
| A | — | 1.20 |
| A1 | 0.05 | 0.15 |
| B | 0.19 | 0.30 |
| C | 0.09 | 0.20 |
| D | 7.70 | 7.90 |
| E | 4.30 | 4.50 |
| e | 0.65 BSC | |
| H | 6.40 BSC | |
| L | 0.45 | 0.75 |
| θ | 0° | 8° |
| γ | 0.10 | |
| bbb | 0.10 | |
| ddd | 0.20 | |

12. Package Outline: 16-Pin SOIC

Figure 6 illustrates the package details for the Si3018. Table 18 lists the values for the dimensions shown in the illustration.

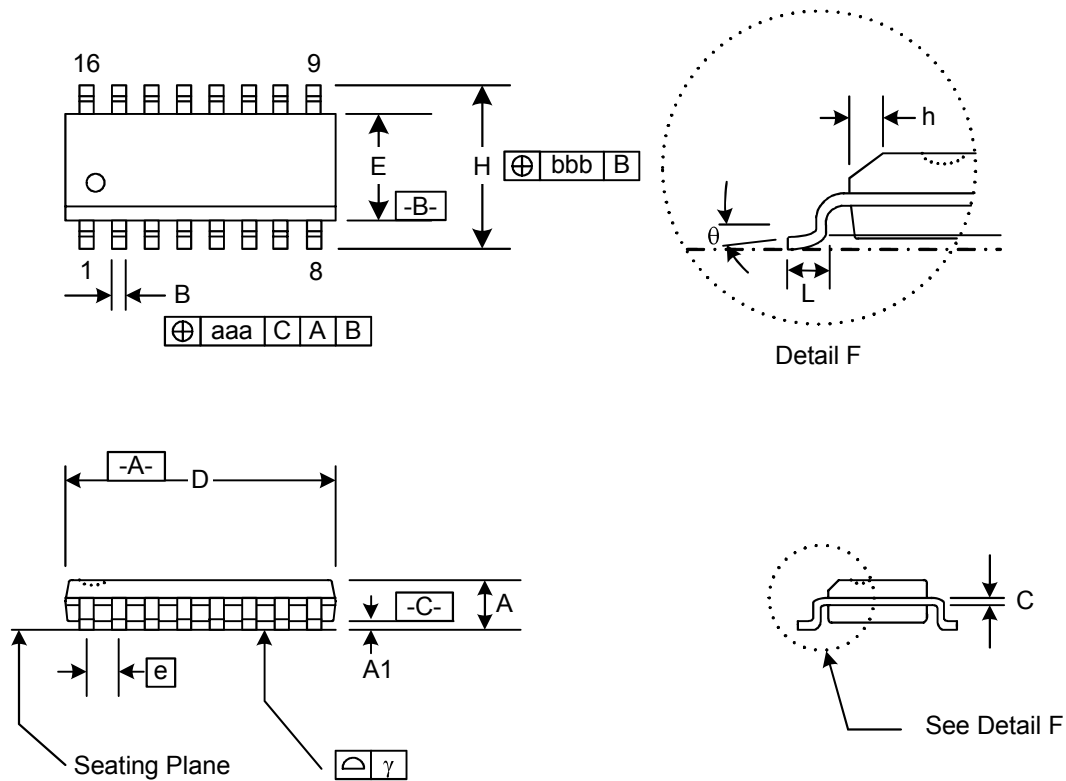


Figure 6. 16-pin Small Outline Integrated Circuit (SOIC) Package

Table 18. Package Diagram Dimensions

| Symbol | Millimeters | |
|----------|-------------|-------|
| | Min | Max |
| A | 1.35 | 1.75 |
| A1 | .10 | .25 |
| B | .33 | .51 |
| C | .19 | .25 |
| D | 9.80 | 10.00 |
| E | 3.80 | 4.00 |
| e | 1.27 BSC | |
| H | 5.80 | 6.20 |
| h | .25 | .50 |
| L | .40 | 1.27 |
| γ | 0.10 | |
| θ | 0° | 8° |
| aaa | 0.25 | |
| bbb | 0.25 | |

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