

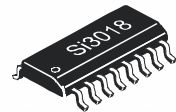
SILICON LABORATORIES

Si2457/34/15/04

V.90, V.34, V.32BIS, V.22BIS ISOMODEM[®] WITH GLOBAL DAA

Features

- Data modem formats
 - ITU-T, Bell
 - 300 bps up to 56 kbps
 - V.21, V.22, V.29 Fast Connect
 - V.42, V.42bis, MNP2-5
 - Automatic rate negotiation
- Type I and II caller ID decode
- No external ROM or RAM required
- UART or parallel interface
- AT command set support
- SMS / MMS support
- Integrated DAA
 - Over 6000 V Capacitive isolation
 - Parallel phone detect
 - Globally-compliant line interface
 - Overcurrent detection
- 27 MHz clock input
- 3.3 V power
- Firmware upgradeable
- EEPROM interface
- Lead-free, RoHS Compliant Packages



Ordering Information

This data sheet is valid only for those chipset combinations listed on page 70.

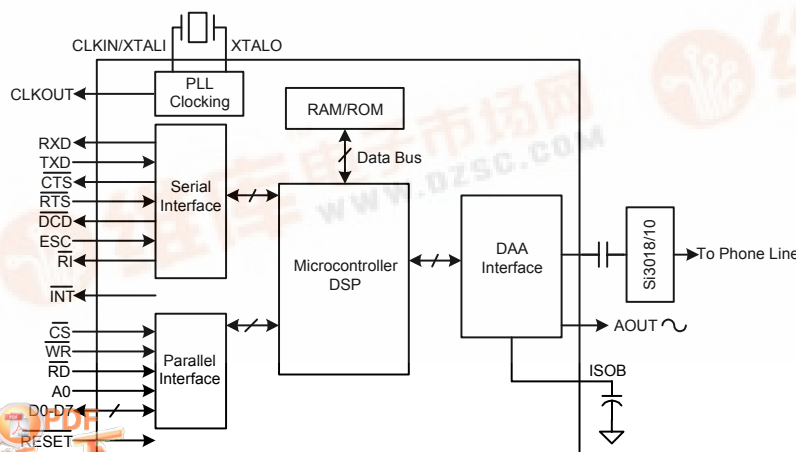
Applications

- Set-top boxes
- Point-of-sale terminals
- Text/video telephones
- Digital video recorder
- Digital televisions
- Remote monitoring

Description

The ISOModem[®] family of products is a complete modem ranging in speed from 56,000 bps to 2400 bps. Offered as a chipset with the Si2457, Si2434, Si2415, or Si2404 system-side device and the Si3018/10 line-side device, the ISOModem utilizes Silicon Laboratories' patented Direct Access Arrangement (DAA) technology to provide a programmable telephone line interface with an unparalleled level of integration. These compact solutions eliminate the need for a separate DSP, modem controller, codec, transformer, relay, opto-isolators, clocking crystal, and 2-4 wire hybrid. Available with a system-side packaging option of either a 16-pin SOIC or a 24-pin TSSOP, these devices are ideal for embedded modem applications due to their flexibility, small footprint, and minimal external component count.

Functional Block Diagram



Pin Assignments

Si2457/34/15/04
(16-Pin Option)

| | | | |
|----------------|---|----|----------------|
| CLKIN/XTALI | 1 | 16 | RTS |
| XTALO | 2 | 15 | DCD |
| RI | 3 | 14 | ESC |
| V _b | 4 | 13 | V _A |
| RXD | 5 | 12 | GND |
| TXD | 6 | 11 | INT |
| CTS | 7 | 10 | C1A |
| RESET | 8 | 9 | C2A |

Si2457/34/15/04
(24-Pin Option)

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

Si3018/10

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

Si2457/34/15/04



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Si2457/34/15/04

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 |
| Si2457/34/15/04 Supply Voltage, Digital ³ | V_D | | 3.0 | 3.3 | 3.6 | V |

Notes:

- The Si2457/34/15/04 specifications are guaranteed when the typical application circuit (including component tolerance) and any Si2457/34/15/04 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 Si2457/34/15/04 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.



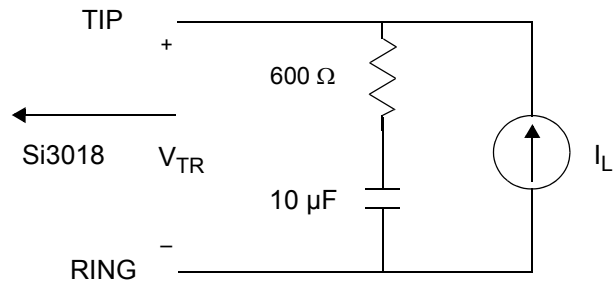


Figure 1. Test Circuit for Loop Characteristics

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 | μA |
| Pullup Resistance Pins 3, 4, 9, 11, 15, 16, 17, 18, 23, 24 (24-pin option) | R_{PU} | | 50 | 125 | 200 | kΩ |
| Pullup Resistance Pins 3, 5, 7, 9, 11, 15, 16 (16-pin option) | R_{PU} | | 50 | 125 | 200 | kΩ |
| Total Supply Current* | I_D | $V_{D3.3}$ pin | — | 26 | 35 | mA |
| Total Supply Current, Powerdown* | I_D | PDN = 1 | — | 80 | — | μA |

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

Si2457/34/15/04

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 |
|---|------------|--|-----|--------|-----|------------|
| Sample Rate | F_s | | — | 8 | — | kHz |
| Clock Input Frequency | F_{XTL} | default | — | 4.9152 | — | MHz |
| Clock Input Frequency | F_{XTL} | ≥ 10 k Ω resistor between DCD 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, Si2457/34/15/04 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

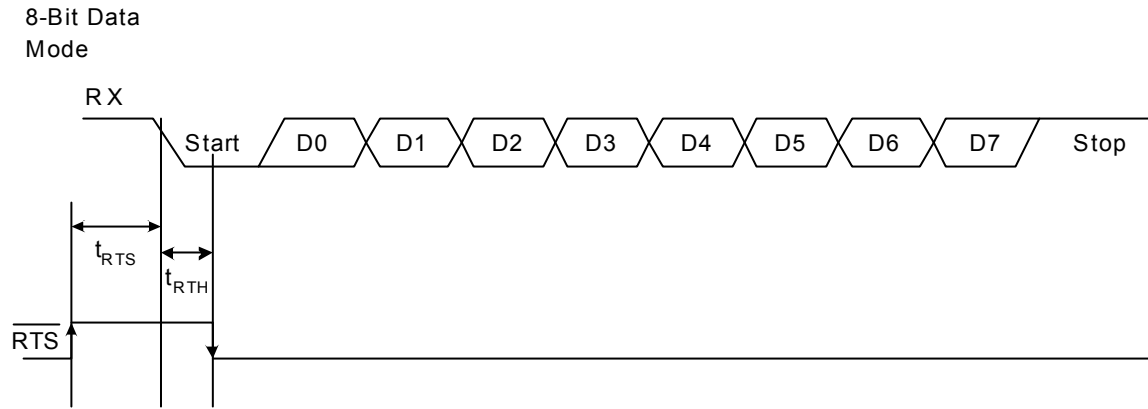
($V_D = 3.0$ to 3.6 V, $T_A = 0$ to 70 °C for F-Grade)

| 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 x 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)

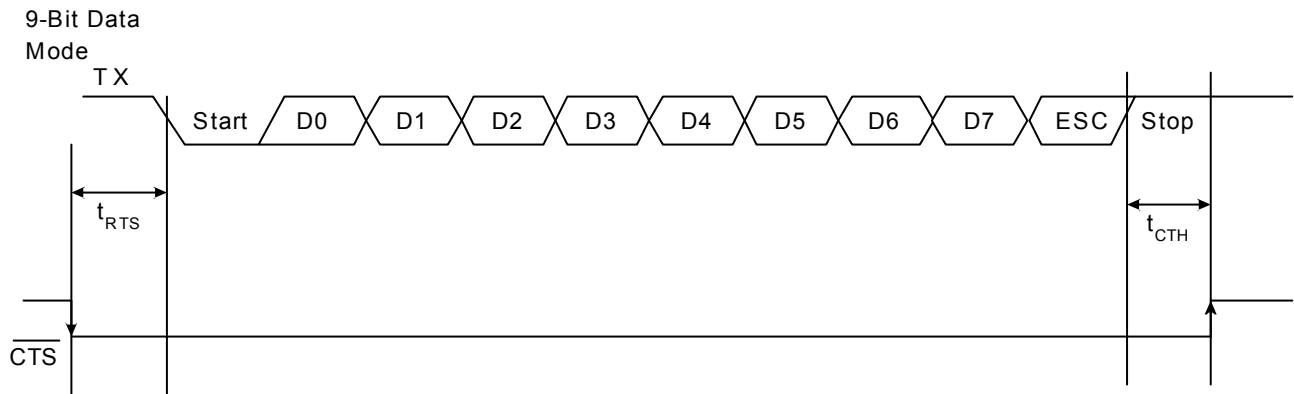


Figure 2. Asynchronous UART Serial Interface Timing Diagram

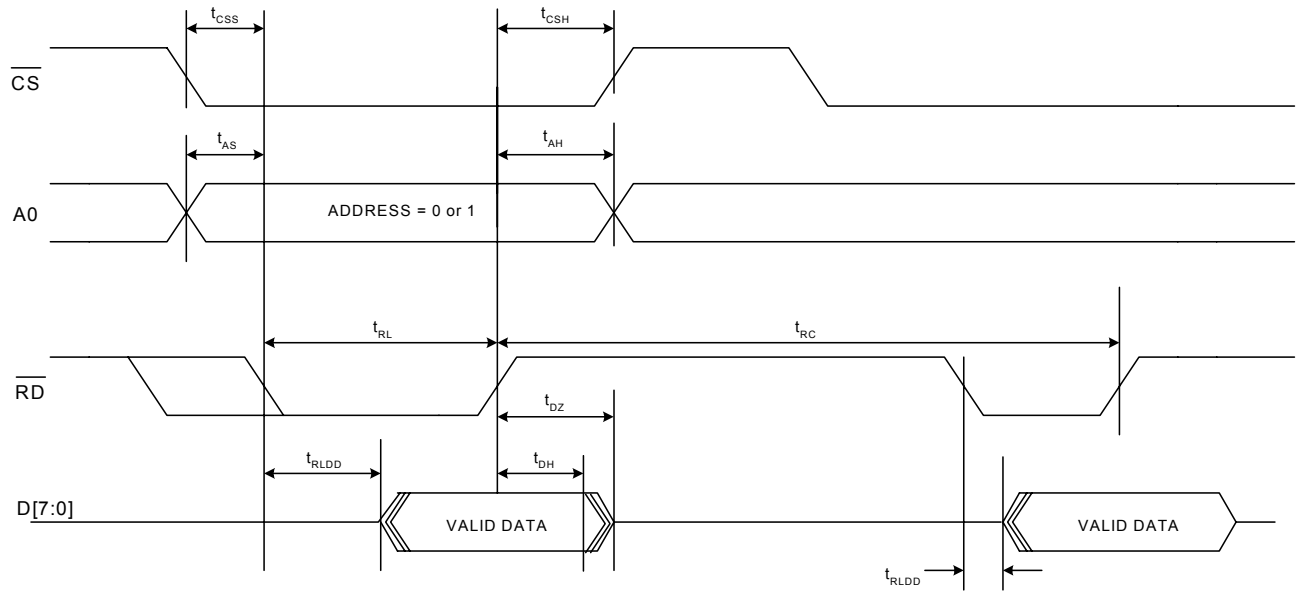


Figure 3. Parallel Interface Read Timing

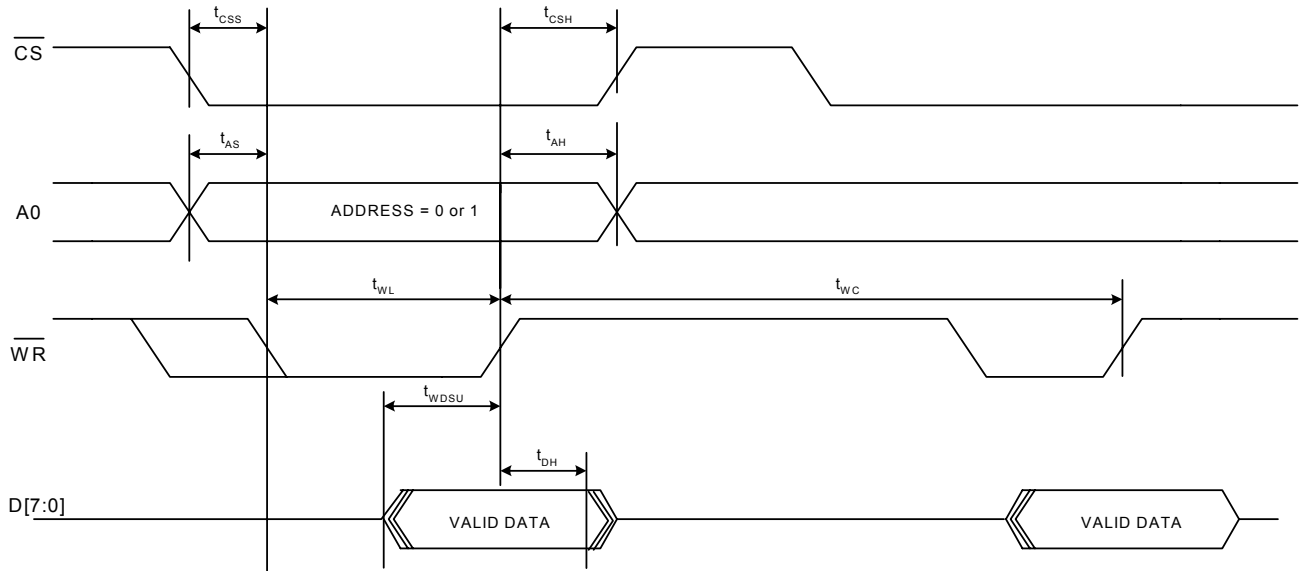


Figure 4. Parallel Interface Write Timing

Si2457/34/15/04

2. Typical Application Schematic

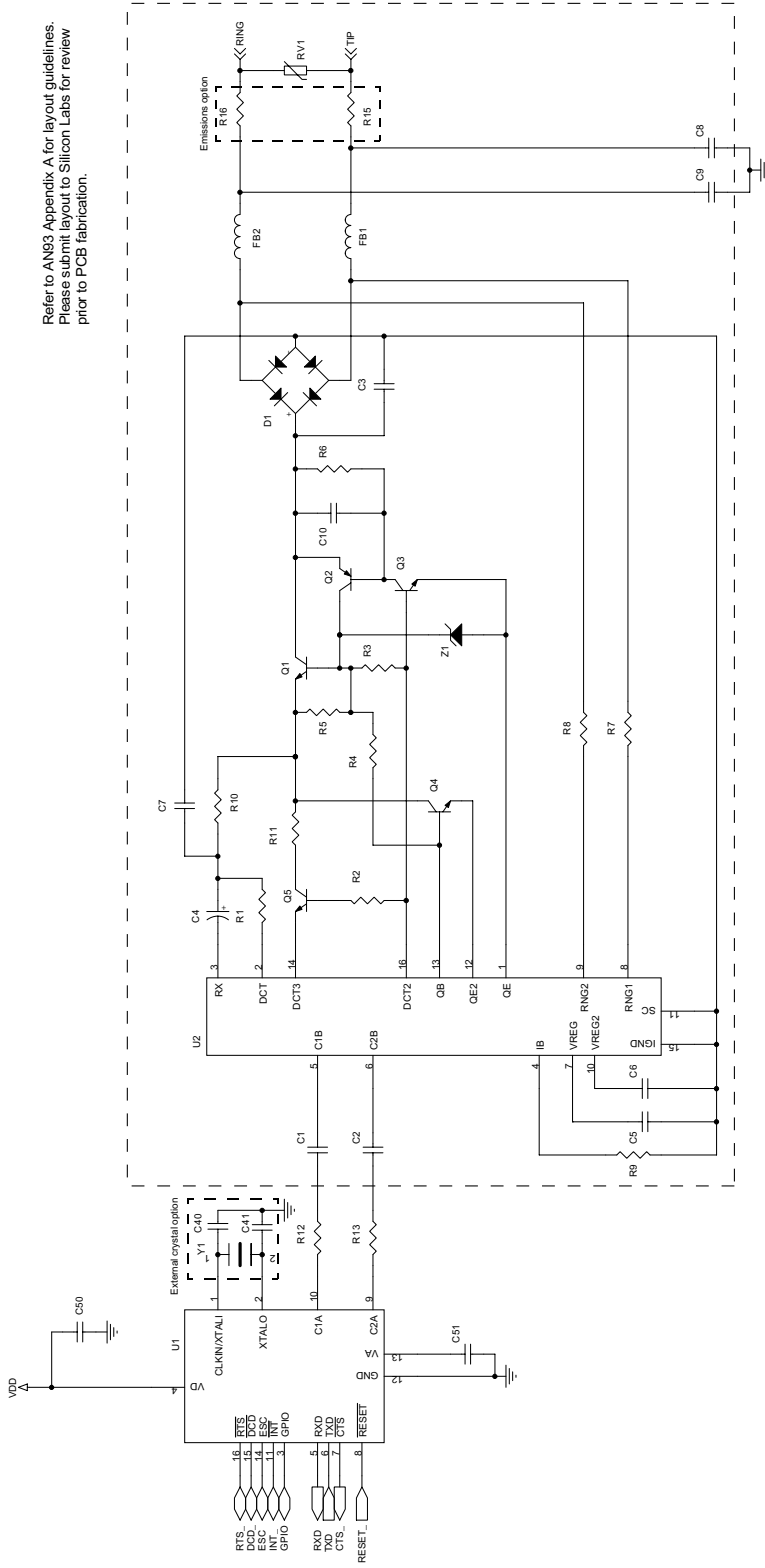


Figure 5. Typical Schematic with 16-pin System-Side Option



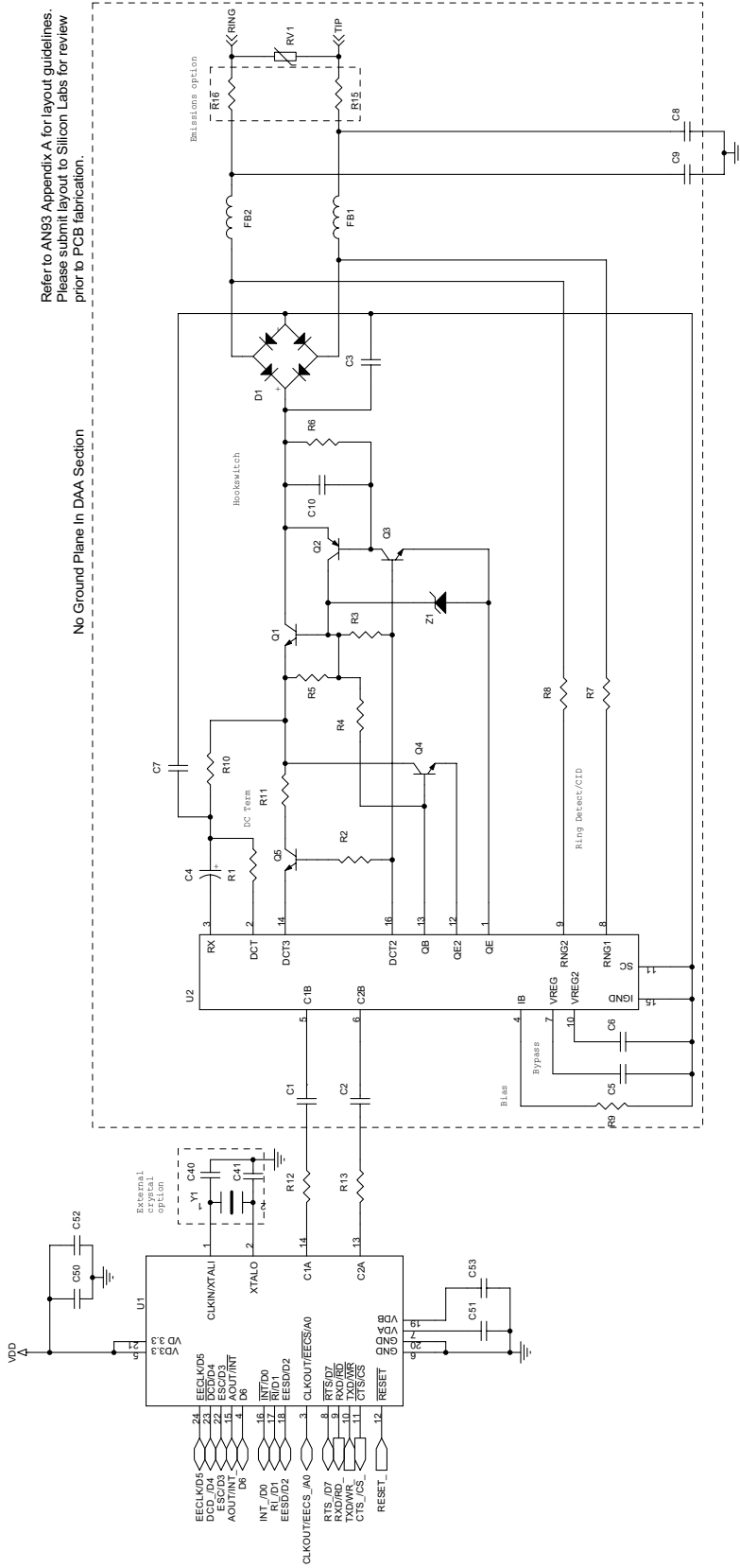


Figure 6. Typical Schematic with 24-pin System-Side Option



Si2457/34/15/04

3. Bill of Materials: Si2457/34/15/04 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 ¹ | 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 ² | 33 pF, 16 V, NPO, ±5% | Venkel, SMEC |
| C51, C53 ¹ | 0.22 µF, 16 V, X7R, ±20% | Venkel, SMEC |
| D1, D2 ³ | 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 | 56 Ω, 1/16 W, 1% | Venkel, SMEC, Panasonic |
| R15, R16 ⁴ | 0 Ω, 1/16 W | Venkel, SMEC, Panasonic |
| U1 | Si2457/34/15/04 | Silicon Labs |
| U2 | Si3018/10 | Silicon Labs |
| Y1 ^{2,5} | 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. C52 and C53 should not be populated with the Si2457/34/15/04 16-pin package option.
2. In STB applications, C40, C41, and Y1 can be removed by using the 27 MHz clock input feature.
3. Several diode bridge configurations are acceptable. For example, a single DF04S or four 1N4004 diodes may be used.
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 |
|--|---|
| Data Rate | |
| 56 kbps ¹ | ITU-T V.90 ¹ |
| 54.666 kbps ¹ | ITU-T V.90 ¹ |
| 53.333 kbps ¹ | ITU-T V.90 ¹ |
| 52 kbps ¹ | ITU-T V.90 ¹ |
| 50.666 kbps ¹ | ITU-T V.90 ¹ |
| 49.333 kbps ¹ | ITU-T V.90 ¹ |
| 48 kbps ¹ | ITU-T V.90 ¹ |
| 46.666 kbps ¹ | ITU-T V.90 ¹ |
| 45.333 kbps ¹ | ITU-T V.90 ¹ |
| 44 kbps ¹ | ITU-T V.90 ¹ |
| 42.666 kbps ¹ | ITU-T V.90 ¹ |
| 41.333 kbps ¹ | ITU-T V.90 ¹ |
| 40 kbps ¹ | ITU-T V.90 ¹ |
| 38.666 kbps ¹ | ITU-T V.90 ¹ |
| 37.333 kbps ¹ | ITU-T V.90 ¹ |
| 36 kbps ¹ | ITU-T V.90 ¹ |
| 34.666 kbps ¹ | ITU-T V.90 ¹ |
| 33.333 kbps ¹ | ITU-T V.90 ¹ |
| 32 kbps ¹ | ITU-T V.90 ¹ |
| 30.666 kbps ¹ | ITU-T V.90 ¹ |
| 29.333 kbps ¹ | ITU-T V.90 ¹ |
| 28 kbps ¹ | ITU-T V.90 ¹ |
| 33.6 kbps ² | ITU-T V.34 ² |
| 31.2 kbps ² | ITU-T V.34 ² |
| 28.8 kbps ² | ITU-T V.34 ² |
| 26.4 kbps ² | ITU-T V.34 ² |
| 24.0 kbps ² | ITU-T V.34 ² |
| 21.6 kbps ² | ITU-T V.34 ² |
| 19.2 kbps ² | ITU-T V.34 ² |
| 16.8 kbps ² | ITU-T V.34 ² |
| 14.4 kbps ³ | ITU-T V.34 or V.32bis ³ |
| 12.0 kbps ³ | ITU-T V.34 or V.32bis ³ |
| 9600 bps ³ | ITU-T V.34, V.32bis, or V.29 ³ |
| 7200 bps ³ | ITU-T V.34 or V.32bis ³ |
| 4800 bps ³ | ITU-T V.34 or V.32bis ³ |
| 2400 bps | ITU-T V.34 or V.22bis ³ |
| 1200 bps | ITU-T V.22bis, V.23, or Bell 212A |
| 300 bps | ITU-T V.21 |
| 300 bps | Bell 103 |
| Data Format | |
| Bit asynchronous | Selectable 8, 9, 10, or 11 bits per character |
| Notes: | |
| 1. Supported on Si2457 only. | |
| 2. Supported on Si2457 and Si2434 only. | |
| 3. Supported on Si2457, Si2434, and Si2415 only. | |

Table 7. Protocol Characteristics (Continued)

| Item | Specification |
|---|--|
| Compatibility | ITU-T V.90 ¹ , V.34 ² , V.32bis, V.32, V.23, V.22bis, V.22, V.21, Bell 212A, and Bell 103 |
| Operating Mode Switched network | Two-wire full duplex |
| Data Modulation 28 to 56 kbps ¹ 2.4 to 33.6 kbps ² 14.4 kbps ³ 12.0 kbps ³ 9600 bps ³ 9600 bps ³ 9600 bps ³ 7200 bps ³ 4800 bps ³ 2400 bps 1200 bps 0 to 300 bps | V.90 as specified by ITU-T V.34 as specified by ITU-T 128-level TCM/2400 Baud ±0.01% 64-level TCM/2400 Baud ±0.01% 32-level TCM/2400 Baud ±0.01% 16-level QAM/2400 Baud ±0.01% V.29 QAM as specified by ITU-T 16-level TCM/2400 Baud ±0.01% 4-level QAM/2400 Baud ±0.01% 16-level QAM/600 Baud ±0.01% 4-level PSK/600 Baud ±0.01% FSK 0–300 Baud ±0.01% |
| Answer Tone ITU-T V.32bis, V.32, V.22bis, V.22, and V.21 modes Bell 212A and 103 modes | 2100 Hz ±3 Hz 2225 Hz ±3 Hz |
| Transmit Carrier V.90 ¹ V.34 ² ITU-T V.32bis ³ ITU-T V.32 ³ ITU-T V.29 ³ ITU-T V.22, V.22bis/Bell 212A Originate mode Answer mode ITU-T V.21 Originate mode Answer mode Bell 103 Originate mode Answer mode | As specified by ITU-T As specified by ITU-T 1800 Hz ±0.01% 1800 Hz ±0.01% 1700 Hz±1 Hz 1200 Hz ±0.5 Hz 2400 Hz ±1 Hz Mark (980 Hz ±12 Hz) Space (1180 Hz ±12 Hz) Mark (1650 Hz ±12 Hz) Space (1850 Hz ±12 Hz) Mark (1270 Hz ±12 Hz) Space (1070 Hz ±12 Hz) Mark (2225 Hz ±12 Hz) Space (2025 Hz ±12 Hz) |
| Output Level Permissive—Switched network | –9 dBm maximum |
| Notes: <ol style="list-style-type: none"> 1. Supported on Si2457 only. 2. Supported on Si2457 and Si2434 only. 3. Supported on Si2457, Si2434, and Si2415 only. | |



Table 7. Protocol Characteristics (Continued)

| Item | Specification |
|--|---|
| Receive Carrier | |
| ITU-T V.90 ¹ | As specified by ITU-T |
| ITU-T V.34 ² | As specified by ITU-T |
| ITU-T V.32bis ³ | 1800 Hz ±7 Hz |
| ITU-T V.32 ³ | 1800 Hz ±7 Hz |
| ITU-T V.29 ³ | 1700 Hz ±7 Hz |
| ITU-T V.22, V.22bis/Bell 212A | 2400 Hz ±7 Hz |
| Originate mode | 1200 Hz ±7 Hz |
| Answer mode | |
| ITU-T V.21 | Mark (980 Hz ±12 Hz) Space (1180 Hz ±12 Hz) |
| Originate mode | Mark (1650 Hz ±12 Hz) Space (1850 Hz ±12 Hz) |
| Answer mode | |
| Bell 103 | Mark (2225 Hz ±12 Hz) Space (2025 Hz ±12 Hz) |
| Originate mode | Mark (1270 Hz ±12 Hz) Space (1070 Hz ±12 Hz) |
| Answer mode | |
| Carrier Detect (level for ITU-T V.22bis, V.22, V.21, 212, 103) in Switched Network | Acquisition (–43 dBm) Release (–48 dBm) |
| Hysteresis | 2 dBm minimum |
| Note: ITU-T V.90 ¹ , V.34 ² , V.32/V.32bis ³ are echo canceling protocols that use signal quality as criteria for maintaining connection. They also provide for self-training detection to force disconnect. | |
| DTE Interface | EIA/TIA-232-E (ITU-T V.24/V.28/ISO 2110) |
| Line Equalization | Automatic Adaptive |
| Connection Options | Loss of Carrier in ITU-T V.22bis and lower |
| Phone Types | 500 (rotary dial), 2500 (DTMF dial) |
| Dialing | Pulse and Tone |
| DTMF Output Level | Per Part 68 |
| Pulse Dial Ratio | Make/Break: 39/61% |
| Ring Cadence | On 2 seconds; Off 4 seconds |
| Call Progress Monitor | BUSY CONNECT (rate) NO ANSWER NO CARRIER NO DIALTONE OK RING RINGING |
| Notes: | |
| 1. Supported on Si2457 only. | |
| 2. Supported on Si2457 and Si2434 only. | |
| 3. Supported on Si2457, Si2434, and Si2415 only. | |

Si2457/34/15/04

4. Functional Description

The Si2457/34/15/04 ISModem[®] is a complete embedded 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 Si2457/34/15/04 accepts standard modem AT commands and provides connect rates up to 56/33.6/14.4/2.4 kbps full-duplex over the Public Switched Telephone Network (PSTN). The Si2457/34/15/04 features a complete set of modem protocols including all ITU-T standard formats up to 56 kbps.

To provide the most flexibility, the Si2457/34/15/04 ISModem system-side device is offered in either a 24-pin TSSOP or a 16-pin SOIC package. The 16-pin version is footprint-compatible with the Si2401 ISModem and is recommended for most applications. The 16-pin version does not support the parallel, EEPROM or voice codec interface. If these features are required, customers should use the 24-pin version.

The ISModem provides numerous additional features for embedded modem applications. The modem includes full type I and type II caller ID detection and decoding for global standards. Call progress monitoring is supported through standard result codes. The modem is also programmable to meet global settings. Because the Si2457/34/15/04 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 embedded modem applications due to its small board space, low power consumption, and global compliance. The Si2457/34/15/04 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 Si2457/34/15/04 has been designed to meet the most stringent worldwide requirements for out-of-band energy, billing-tone immunity, surge immunity, and safety requirements.

The Si2457/34/15/04 allows for rapid integration into existing modem applications by providing 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.

4.1. Serial Interface

The Si2457/34/15/04 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).

To ensure backward compatibility when using a 24-pin system side option, if a pulldown resistor $\leq 10 \text{ k}\Omega$ is placed between D2 (Si2457/34/15/04, pin 18) and GND (Si2457/34/15/04, pin 6), the DTE rate is set to a 19.2 kbps baud rate (see Table 8).

4.1.1. Autobaud

The Si2457/34/15/04 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. This feature is enabled by default.

4.2. Parallel Interface (24-Pin Version Only)

The Si2457/34/15/04 digital I/O can communicate via a 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 page 64. If $A0 = 1$, the data bus represents a read/write to the "Parallel Interface 1 (0x01)" register on page page 65).

Selection of a serial or parallel I/O interface is determined by the state of $\text{AOUT}/\overline{\text{INT}}$ (Si2457/34/15/04, pin 15) during the rising edge of RESET . An internal pullup resistor forces the default state to serial mode operation. An external $10 \text{ k}\Omega$ pulldown resistor can be connected to $\text{AOUT}/\overline{\text{INT}}$ 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.



Table 8. Pulldown Selector (24-Pin SSD)

| Mode | Serial I/O | Parallel I/O |
|----------------|------------|--------------|
| 4.9152 MHz CLK | Default | Pin 15 |
| 27 MHz CLK | Pin 23 | Pin 11, 15 |
| Autobaud | Default | N/A |
| 19.2 kbps DTE | Pin 18 | |
| No EEPROM | Default | N/A |
| EEPROM | Pin 4 | |

Table 9. Pulldown Selector (16-Pin Version)

| Mode | Serial I/O |
|----------------|------------|
| 4.9152 MHz CLK | Default |
| 27 MHz CLK | Pin 15 |

4.3. Command Mode

Upon reset, the ISModem[®] is in command mode and accepts “AT” commands. An outgoing modem call can be made using the “ATDT#” (tone dial) or “ATDP#” (pulse dial) command after the device is configured. If the handshake is successful, the modem responds with the response codes detailed in Table 14 on page 36 and enters data mode.

4.4. Data Mode

The Si2457/34/15/04 ISModem is in data mode while it has a telephone line connection to another modem or is in the process of establishing a connection.

Data protocols are available to provide error correction to improve reliability (V.42 and MNP2-4) and data compression to increase throughput (V.42bis and MNP5).

Each connection between two modems in data mode begins with a handshaking sequence. During this sequence, the modems determine the line speed, data protocol, and related parameters for the data link. Configuration through AT commands determines the range of choices available to the modem during the negotiation process.

4.5. Fast Connect

The Si2457/34/15/04 supports a fast connect mode of operation to reduce the time of a connect sequence in originate mode. The Fast Connect modes can be enabled for V.21, V.22, Bell103, and V.29 modulations. See “AN93: Modem Designer’s Guide” for details.

4.6. V.80 Synchronous Access Mode

The Si2457/34/15/04 supports a V.80 synchronous

access mode of operation, which operates with an asynchronous DTE and a synchronous DCE. See “AN93: Modem Designer’s Guide” for complete details.

4.7. Clocking/Low Power Modes

The Si2457/34/15/04 contains an on-chip phase-locked loop (PLL) and clock generator. Using either a single crystal or master clock input, the Si2457/34/15/04 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 Si2457/34/15/04 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 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 Tables 8 and 9).

Using the S24 S-register, the Si2457/34/15/04 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. The ISModem remains in the sleep state until either a 1 to 0 transition on TXD (serial mode) or a 1 to 0 transition on \overline{CS} (parallel mode) occurs.

Additionally, the Si2457/34/15/04 may be placed in a complete powerdown mode or wake-on-ring mode. Complete powerdown is accomplished via U65[13] (PDN). Once the PDN bit is written, the Si2457/34/15/04 completely powers down and can only be powered back on via the RESET pin.

4.8. Data Compression

The modem can achieve DTE (host-to-ISModem) speeds greater than the maximum DCE (modem-to-modem) speed through the use of a data compression protocol. The compression protocols available are the ITU-T V.42bis and MNP5 protocols. Data compression attempts to increase throughput by compressing the data before actually sending it. Thus, the modem is able to transmit more data in a given period of time.

4.9. Error Correction

The Si2457/34/15/04 ISModem can employ error correction (reliable) protocols to ensure error-free delivery of asynchronous data sent between the host and the remote end. The Si2457/34/15/04 supports V.42



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and MNP2-4 error correction protocols. V.42 (LAPM) is most commonly used and is enabled by default.

4.10. Wire Mode

Wire mode is used to communicate with standard non-error correcting modems. When optioned with \N3, the Si2457/34/15/04 falls back to wire mode if it fails in an attempt to negotiate a V.42 link with the remote modem. Error correction and data compression are not active in wire mode.

4.11. Caller ID Operation

The Si2457/34/15/04 supports full type I and type II caller ID detection and decode. Caller ID is supported for the US Bellcore, European ETSI, UK, and Japanese protocols and is enabled via the +VCID, +VCDT, and +PCW commands.

4.12. Parallel Phone Detection

The ISModem[®] is able to detect when another telephone, modem, or other device is using the phone line. 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 using the phone line.

When the ISModem is sharing the telephone line with other devices, it is important that it not interrupt a call in progress. To detect whether another device is using the shared telephone line, the host can use the ISModem to monitor the TIP-RING dc voltage with the line voltage sense (LVS) register (U6C, bits 15:8). The LVS bits have a resolution of 1 V per bit with an accuracy of approximately $\pm 10\%$. Bits 0 through 6 of this 8-bit signed twos complement number indicate the value of the line voltage, and the sign bit (bit 7) indicates the polarity of TIP and RING. The ISModem can also monitor the TIP-RING dc voltage using the LVCS register (U79, bits 4:0). See Figure 7 on page 18. See also the %Vn commands for automatic line-in-use detection.

4.12.2. Off-Hook Intrusion Detection

When the ISModem is off-hook, an algorithm is implemented in the ISModem to automatically monitor the TIP-RING loop current via the LVCS register. During the off-hook state, the LVCS register switches from representing the TIP-RING voltage to representing the TIP-RING current. See Figure 8 on page 19. Upon detecting an intrusion, the ISModem alerts the host of the condition via the INT pin.

4.12.1. On-Hook Line-in-use Detection

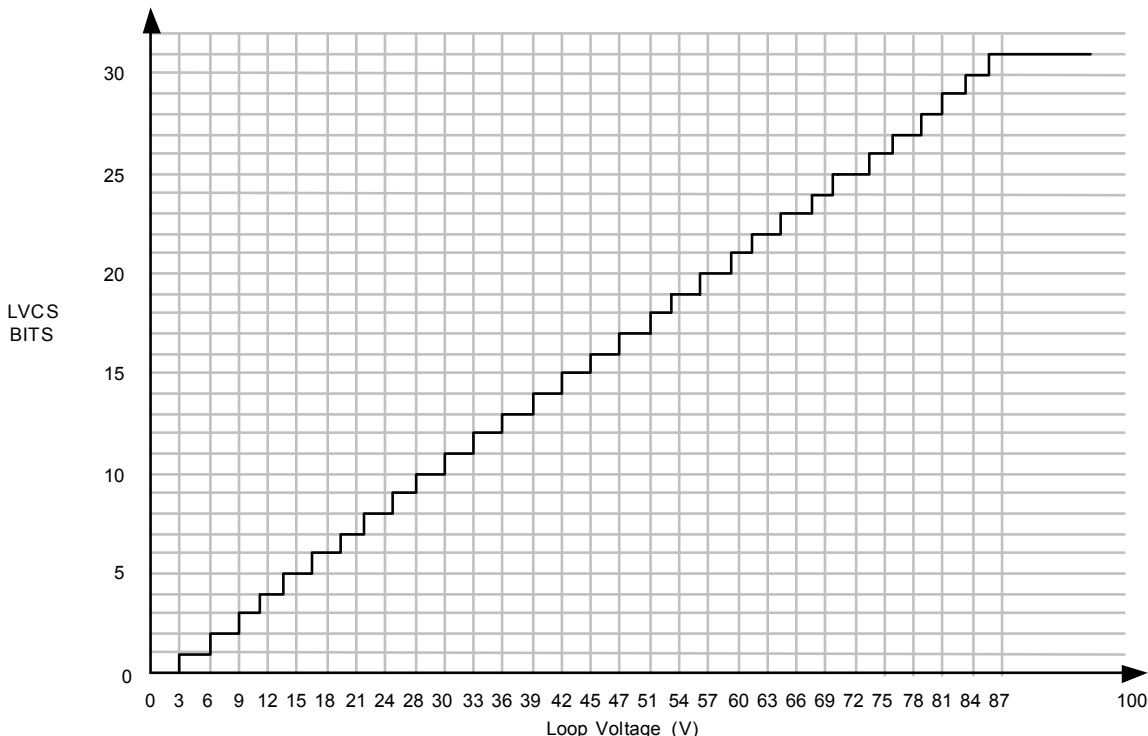


Figure 7. Loop Voltage



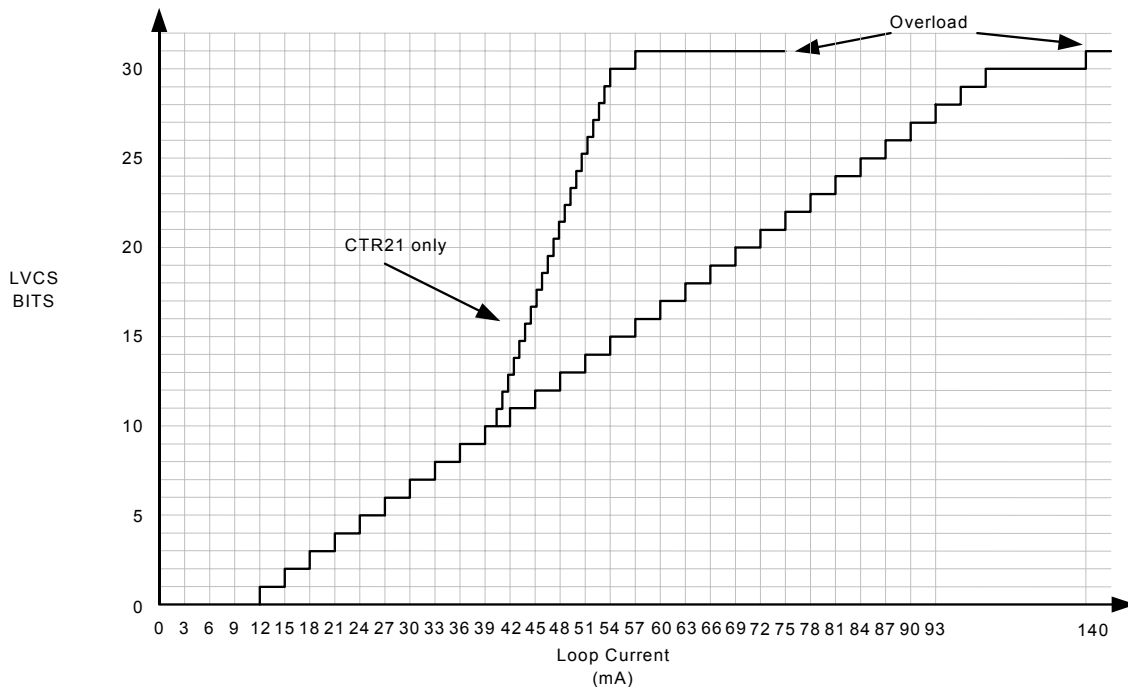


Figure 8. Loop Current

4.13. Overcurrent Detection

The Si2457/34/15/04 includes an overcurrent detection feature that measures the loop current at a programmable time after the Si2457/34/15/04 goes off-hook. This allows the Si2457/34/15/04 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. See “AN93: Modem Designer’s Guide” for details.

4.14. Global Operation

The Si2457/34/15/04 chipset contains an integrated silicon direct access arrangement (Silicon DAA) that provides a programmable line interface to meet international telephone line interface requirements. “AN93: Modem Designer’s Guide” gives the DAA register settings required to meet international PTT standards.

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. See “AN93: Modem Designer’s Guide” for complete details.

4.15. Firmware Upgrades

The Si2457/34/15/04 contains an on-chip program ROM that includes the firmware required for the features listed in this data sheet. In addition, the Si2457/34/15/04 contains on-chip program RAM to accommodate minor changes to the ROM 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. See “AN93: Modem Designer’s Guide” for complete details.

4.16. SMS / MMS Support

The Si2457/34/15/04 supports V.23 half-duplex modulation. This modulation provides the low-level functionality needed for SMS and MMS protocols. See “AN93: Modem Designer’s Guide” for complete details.

4.17. Codec Interface (24-Pin Version Only)

In order to support a full range of voice and data applications, the Si2457/34/15/04 includes an optional serial interface that connects to an external voice codec (Si3000). See “AN93: Modem Designer’s Guide” for complete details.

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4.18. EEPROM Interface (24-Pin Version Only)

The Si2457/34/15/04 supports an optional serial peripheral interface (SPI) bus serial EEPROM Mode 3 with a 16-bit (8–64 kbit range) address. Upon powerup, if a pulldown resistor $\leq 10\text{ k}\Omega$ is placed between D6 (Si2457, pin 4) and GND (see Table 8), the ISOmodem attempts to detect an EEPROM. The EEPROM is intended first for setting custom defaults, second for automatically loading firmware upgrades, and third to allow for user-defined AT command macros for use in custom AT commands or country codes. See “AN93: Modem Designer’s Guide” for complete details.

4.19. AT Commands

At powerup, the Si2457/34/15/04 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 | Dial The dial command, followed by 1 or more dial command modifiers, manually dials a phone number: | |
| | 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. |
| | G | Polarity reversal detect. By placing the “G” character in the dial string (i.e. ATDTG1), the Si2457/34/15/04 will monitor the telephone line for polarity reversals. If a busy tone is detected, the Si2457/34/15/04 will report “POLARITY REVERSAL” if a polarity reversal was detected or “NO POLARITY REVERSAL” if a polarity reversal was not detected. In each case, the result code is followed by “OK”. If the S7 timeout occurs before a busy tone is detected, the Si2457/34/15/04 will report “NO CARRIER”. Polarity reversal monitoring begins after the last digit is dialed and ends when the busy tone is detected or S7 timeout occurs. Note: It is not possible to establish a modem connection when using this command. |
| | 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 | 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. If the DOP bit (U7A, bit 7) is set, the “ATDTW” command will cause the ISOmodem® to pause dialing and either report an “OK” if a dialtone is detected or “NO DIALTONE” if a dial tone is not detected. | |
| En | Local DTE echo | |
| E0 | Disable | |
| E1 | Enable | |
| Hn | Hook switch. | |
| H0 | Go on-hook (hang up modem). | |



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

| Command | Action |
|-----------|---|
| H1 | Go off-hook. |
| In | Identification and checksum. |
| I0 | Display Si2457/34/15/04 revision code. B: Revision B C: Revision C, etc. |
| I1 | Display Si2457/34/15/04 firmware revision code (numeric). |
| I3 | Display line-side revision code. 18C = Si3018 revision C |
| I6 | Display the ISOmodem® model number. “2404” = Si2404 “2415” = Si2415 “2434” = Si2434 “2457” = Si2457 |
| I7 | Diagnostic results 1. See “AN93: Modem Designer’s Guide” for details. |
| I8 | Diagnostic results 2. See “AN93: Modem Designer’s Guide” for details. |
| 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. |
| On | Return to data mode from Command mode operation. |
| O0 | Return to data mode. |
| O1 | Return to data mode and perform a full retrain (at any speed except 300 bps). |
| O2 | Return to data mode and perform rate renegotiation. |
| Qn | Response mode. |
| Q0 | Enable result codes (see Table 14 on page 36) |
| Q1 | Disable result codes (enable quiet mode). |
| R | Initiate V.23 reversal. |
| Sn | S-register operation (see Table 15 on page 39). |
| 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 14 on page 36). |
| V0 | Numeric result codes. |
| V1 | Verbal result codes |



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

| Command | Action |
|-----------|--|
| Xn | Call Progress Monitor (CPM)—This command controls which CPM signals are monitored and reported to the host from the Si2457/34/15/04. (See Table 14 on page 36.) |
| 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. |
| Yn | Long space disconnect—Modem hangs up after 1.5 seconds or more of continuous space while on-line. |
| Y0 | Disable. |
| Y1 | Enable. |
| Z | Hard Reset—This command is functionally equivalent to pulsing the RESET pin low. (See t_{AT} in Table 6 on page 7.) |
| :E | Read from serial EEPROM. |
| :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. |
| :M | Write to serial EEPROM. |
| :P | Program RAM Write—This command is used to upload firmware supplied by Silicon Labs to the Si2457/34/15/04. 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 page 42–page 60.) The format is “AT:Raa”, where aa = user-access address in hexadecimal. The “AT:R” command causes all the U- registers to be displayed. |
| :U | User-Access Register Write—This command allows the user to write to the 16-bit user-access registers. (See page page 42.) The format is “AT:Uaa,xxxx,yyyy,zzzz,...” where aa = user-access address in hexadecimal. xxxx = Data in hexadecimal to be written to location aa. yyyy = Data in hexadecimal to be written to location (aa + 1). zzzz = Data in hexadecimal to be written to location (aa + 2). etc. |

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

| Command | Action |
|--|--|
| <p>+DR=X</p> | <p>Data compression reporting.</p> <p><u>X</u> <u>Mode</u></p> <p>0 Disabled</p> <p>1 Enabled</p> <p>If enabled, the intermediate result code is transmitted at the point after error control negotiation. The format of this result code is as follows:</p> <p><u>Result code</u> <u>Mode</u></p> <p>+DR:NONE Data compression is not in use</p> <p>+DR:V42B Rec. V.42bis is in use in both directions</p> <p>+DR:V42B RD Rec. V.42bis is in use in receive direction only</p> <p>+DR:V42B TD Rec. V.42bis is in use in transmit directions only</p> |
| <p>+DS Options</p> <p>+DS = A</p> <p>+DS = A,B</p> <p>+DS = A,B,C</p> <p>+DS = A,B,C,D</p> | <p>Controls V.42bis data compression function.</p> <p>A Direction</p> <p> 0 No compression</p> <p> 1 Transmit only</p> <p> 2 Receive only</p> <p> 3 Both Directions</p> <p>B Compression_negotiation</p> <p> 0 Do not disconnect if V.42 is not negotiated.</p> <p> 1 Disconnect is V.42 is not negotiated.</p> <p>C Maximum dictionary size</p> <p> 512</p> <p>D Maximum string size</p> <p> 6 to 250 (28 default)</p> |
| <p>+ES Options</p> <p>+ES = A</p> <p>+ES = A,,C</p> | <p>Enable synchronous access mode.</p> <p>A Specifies the mode of operation when initiating a modem connection.</p> <p> D Disable synchronous access mode.</p> <p> 6 Enable synchronous access mode when connection is completed and data state is entered.</p> <p>B Specifies fallback mode of operation.</p> <p> This parameter should not be used.</p> <p>C Specifies the mode of operation when answer a modem connection.</p> <p> D Disable synchronous access mode.</p> <p> 8 Enable synchronous access mode when connection is completed and data state is entered.</p> |



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

| Command | Action |
|--|--|
| +ESA Options +ESA = A +ESA = A,B +ESA = A,B,C +ESA = A,B,C,E +ESA = A,B,C,E,F +ESA = A,B,C,E,F,G | Synchronous access mode control options A Specifies action taken if an underrun condition occurs during transparent sub-mode. 0 Modem transmits 8-bit SYN sequences on idle. B Specifies action taken if an underrun condition occurs after a flag during framed sub-mode 0 Modem transmits 8-bit HDLC flags on idle. C Specifies action taken if an underrun or overrun condition occurs after a non-flag during framed sub-mode. 0 Modem transmits abort on underrun in middle of frame. 1 Modem transmits flag on underrun in middle of frame and notifies host of underrun or overrun. D Specifies V.34 half duplex operation. This parameter should not be used. E Specifies CRC polynomial used while in framed sub-mode. 0 CRC generation checking disable. 1 16-bit CRC generation and checking is performed by the modem. F Specifies NRZI encoding and decoding. 0 NRZI encoding and decoding disabled. G Specifies SYN. 255 |
| +FCLASS = X | Class 1 Mode Enable for V.29 fast connect. X <u>Mode</u> 0 Off 1 Enables support for Class 1 mode for use in the V.29 fast connect mode. |
| +FRM = X | Class 1 Receive Carrier for V.29 fast connect. X <u>Mode</u> 2 Transmit V.21 (980 Hz) tone for longer than 100 ms, then send answer tone (2100/2225 Hz) for 200 ms. 95 V.29 short synchronous. 96 V.29 full synchronous. |
| +FTM = X | Class 1 Transmit Carrier for V.29 fast connect. X <u>Mode</u> 2 Transmit V.21 (980 Hz) tone. 53 Same as &T4, but transmit V.29 7200 bps. Data pattern set by S40 register. AT + FCLASS = 0 must be sent to restore the ISOmodem® to normal operation after test. 54 Same as &T4, but transmit V.29 9600 bps. Data pattern set by S40 register. AT + FCLASS = 0 must be sent to restore the ISOmodem to normal operation after test. 95 V.29 short synchronous. 96 V.29 full synchronous. |

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

| Command | Action | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------|---|---|----------------|---|-------|---|-----------|---|---------|---|---------|----|--------|----|----------|----|--------|----|-------|----|----------|----|----------------|----|---------|----|---------|----|---------|----|--------|----|---------|----|--------|----|-----------|----|---------|----|-------|----|---------|----|--------|----|-------|----|-------------|----|------------|----|----------|----|--------|----|-------------|----|-------------|----|--------|----|----------|----|-------------|----|--------|----|----------|----|-----------|----|--------------|----|-------|----|--------|----|-------------|----|--------|----|----------------|-----------|----------------------|----|--------|
| +GCI = X | <p>Country settings - Automatically configure all registers for a particular country.</p> <table border="0"> <tr><td>X</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. Refer to "AN93: Modem Designer's Guide" for details.</p> | X | <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 |
| X | <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>) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +GCI = ? | List all possible country code settings. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



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

| Command | Action |
|---|--|
| +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 1 Local XON/OFF flow control. Does not pass XON/XOFF character to the remote modem. 2 Hardware flow control (RTS) B Specifies the flow control method used by the modem to control data from the host 0 None 1 Local XON/OFF flow control. 2 Hardware flow control (CTS). |
| +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 = X | Modulation reporting control. <u>X</u> Mode 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: V32B +MRR: <rate> e.g. +MRR: 14400 |
| +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 | Modulation Selection. A Preferred modem carrier V21 ITU-T V.21 V22 ITU-T V.22 V22B ITU-T V.22bis (default for Si2404) V32 ITU-T V.32 V32B ITU-T V.32bis (default for Si2415) V34 ITU-T V.34 (default for Si2434) V90 ITU-T V.90 (default for Si2457) B Automatic modulation negotiation 0 Disabled 1 Enabled 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. 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. |

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

| Command | Action |
|-----------|--|
| +PCW = X | Controls the action to be taken upon detection of call waiting. <u>X</u> <u>Mode</u> 0 Toggle \overline{RT} and collect type II Caller ID if enabled by +VCID. 1 Hang up. 2 Ignore call waiting. |
| +VCDT = X | Caller ID Type. <u>X</u> <u>Mode</u> 0 After ring only 1 Always on 2 UK 3 Japan |
| +VCID = X | Caller ID Enable. <u>X</u> <u>Mode</u> 0 Off 1 On—formatted 2 On—raw data format |
| +VCIDR? | Type II caller ID information — The Si2493 will display “+VCDIR:” followed by raw caller ID information including checksum. |



4.20. Extended AT Commands

The extended AT commands are supported by the Si2457/34/15/04 and are described in Tables 11 through 13.

Table 11. Extended AT& Command Set (Command Defaults in Bold)

| Command | Action |
|-----------------|---|
| &\$ | Display AT& current settings. |
| &D0 | ESC is not used |
| &D1 | ESC escapes to command mode from data mode if also enabled by HES U70, bit 15. |
| &D2 | ESC assertion during a modem connection causes the modem to go on-hook and return to command mode. |
| &D3 | ESC assertion causes ATZ command (reset and return OK result code). |
| &F | Restore factory default settings. |
| &Gn | Line connection rate limit—This command sets an upper limit on the line speed that the Si2457/34/15/04 can connect. Note that the &Hn commands may limit the line speed as well (&Gn not used for &H0 or &H1). Not all modulations support rates given by &G. Any improper setting will be ignored. |
| &G3 | 1200 bps max |
| &G4 | 2400 bps max (default for Si2404) |
| &G5 | 4.8 kbps max |
| &G6 | 7.2 kbps max |
| &G7 | 9.6 kbps max |
| &G8 | 12 kbps max |
| &G9 | 14.4 kbps max (default for Si2415) |
| &G10 | 16.8 kbps max |
| &G11 | 19.2 kbps max |
| &G12 | 21.6 kbps max |
| &G13 | 24 kbps max |
| &G14 | 26.4 kbps max |
| &G15 | 28.8 kbps max |
| &G16 | 31.2 kbps max |
| &G17 | 33.6 kbps max (default for Si2457 and Si2434) |
| &Hn | Switched network handshake mode—&Hn commands must be on a separate command line from ATD, ATA, or ATO commands. |
| &H0 | V.90 with automatic fallback (56 kbps to 300 bps) (default for Si2457) |
| &H1 | V.90 only (56 kbps to 28 kbps) |
| &H2 | V.34 with automatic fallback (33.6 kbps to 300 bps) (default for Si2434) |
| &H3 | V.34 only (33.6 kbps to 2400 bps) |



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Table 11. Extended AT& Command Set (Command Defaults in Bold) (Continued)

| Command | Action |
|----------------|--|
| &H4 | ITU-T V.32bis with automatic fallback (14.4 kbps to 300 bps) (default for Si2415) |
| &H5 | ITU-T V.32bis only (14.4 kbps to 4800 bps) |
| &H6 | ITU-T V.22bis only (2400 bps or 1200 bps) |
| &H7 | ITU-T V.22 only (1200 bps) |
| &H8 | Bell 212 only (1200 bps) |
| &H9 | Bell 103 only (300 bps) |
| &H10 | ITU-T V.21 only (300 bps) |
| &H11 | V.23 (1200/75 bps) |
| &Pn | Japan pulse dialing |
| &P0 | Configure Si2457/34/15/04 for 10 pulse-per-second pulse dialing. For Japan. |
| &P1 | Configure Si2457/34/15/04 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 &H AT command. Test loop is through the DSP (Si2457/34/15/04 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 &H AT command. Test loop is through the DSP (Si2457/34/15/04), DAA interface section (Si2457/34/15/04), 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 &H, &G, 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 &H, &G, 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. |
| &Xn | Automatic determination of telephone line type. |
| &X0 | Abort &x1 or &x2 command. |



Table 11. Extended AT& Command Set (Command Defaults in Bold) (Continued)

| Command | Action |
|---------|--|
| &X1 | Automatic determination of telephone line type. Result code: WXYZn W: 0 = line supports DTMF dialing. 1 = line is pulse dial only. X: 0 = line supports 20 pps dialing. 1 = line supports 10 pps dialing only. Y: 0 = extension network present (PBX). 1 = outside line (PSTN) connected directly. Z: 0 = continuous dialtone. 1 = make-break dialtone. n: 0–9 (number required for outside line if Y = 0). Note: The initial number attempted for an outside line is controlled in S51. |
| &X2 | Same as &X1, but Y result (PBX) is not tested. |
| *Y2A | Produce a constant answer tone (ITU-T) and return to command mode. The answer tone continues until the ATH command is received or the S7 timer expires. |
| &Z | Enter low-power wake-on-ring mode. |

Table 12. Extended AT% Command Set (Command Defaults in Bold)

| Command | Action |
|------------|---|
| %%\$ | Display AT% command settings. |
| %B | Report blacklist. See also S42 register. |
| %Cn | Data compression |
| %C0 | Disable V.42bis and MNP5 data compression |
| %C1 | Enable V.42bis in transmit and receive paths. If MNP is selected (IN2), then %C1 enables MNP5 in transmit and receive paths. |
| %C2 | Enable V.42bis in transmit path only. |
| %C3 | Enable V.42bis in receive path only. |
| %On | Answer mode. |
| %O1 | Si2457/34/15/04 will auto-answer a call in answer mode. |
| %O2 | Si2457/34/15/04 will auto-answer a call in originate mode. |
| %Vn | Automatic Line Status Detection. After the %V1 and %V2 commands are issued, the Si2457/34/15/04 will automatically check the telephone connection for whether or not a line is present. If a line is present, the Si2457/34/15/04 will automatically check if the line is already in use. Finally, the Si2457/34/15/04 will check line status both before going off-hook and again before dialing. %V1 uses the fixed method, and %V2 uses the adaptive method. %V0 (default) disables this feature. |
| %V0 | Disable automatic line-in-use detection. |



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Table 12. Extended AT% Command Set (Command Defaults in Bold) (Continued)

| Command | Action | | | | | | | | |
|---|--|---------------------|---------------|---|--------------------------------------|---|--|-----------------------------|---|
| <p>%V1</p> | <p>Automatic Line Status Detection—Fixed Method. Description: Before going off-hook with the ATD, ATO, or ATA commands, the Si2457/34/15/04 compares the line voltage (via LVCS) to registers NOLN (U83) and LIUS (U84):</p> <table border="0"> <thead> <tr> <th data-bbox="305 548 464 575"><u>Loop Voltage</u></th> <th data-bbox="618 548 695 575"><u>Action</u></th> </tr> </thead> <tbody> <tr> <td data-bbox="305 579 521 606">$0 \leq LVCS \leq NOLN$</td> <td data-bbox="618 579 1078 606">Report “NO LINE” and remain on-hook.</td> </tr> <tr> <td data-bbox="305 611 570 638">$NOLN \leq LVCS \leq LIUS$</td> <td data-bbox="618 611 1127 638">Report “LINE IN USE” and remain on-hook.</td> </tr> <tr> <td data-bbox="305 642 467 669">$LIUS \leq LVCS$</td> <td data-bbox="618 642 1180 669">Go off-hook and establish a modem connection.</td> </tr> </tbody> </table> <p>Once the call has begun, the off-hook intrusion algorithm (described in "4.12.2. Off-Hook Intrusion Detection" on page 18) operates normally. In addition, the Si2457/34/15/04 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.</p> | <u>Loop Voltage</u> | <u>Action</u> | $0 \leq LVCS \leq NOLN$ | Report “NO LINE” and remain on-hook. | $NOLN \leq LVCS \leq LIUS$ | Report “LINE IN USE” and remain on-hook. | $LIUS \leq LVCS$ | Go off-hook and establish a modem connection. |
| <u>Loop Voltage</u> | <u>Action</u> | | | | | | | | |
| $0 \leq LVCS \leq NOLN$ | Report “NO LINE” and remain on-hook. | | | | | | | | |
| $NOLN \leq LVCS \leq LIUS$ | Report “LINE IN USE” and remain on-hook. | | | | | | | | |
| $LIUS \leq LVCS$ | Go off-hook and establish a modem connection. | | | | | | | | |
| <p>%V2</p> | <p>Automatic Line Status Detection—Adaptive Method. Description: Before going off-hook with the ATD, ATO, or ATA commands, the Si2457/34/15/04 compares the line voltage (via LVCS) to the NLIU (U85) register:</p> <table border="0"> <thead> <tr> <th data-bbox="305 968 464 995"><u>Loop Voltage</u></th> <th data-bbox="808 968 885 995"><u>Action</u></th> </tr> </thead> <tbody> <tr> <td data-bbox="305 999 639 1026">$0 \leq LVCS \leq (0.0625 \times NLIU)$</td> <td data-bbox="808 999 1268 1026">Report “NO LINE” and remain on-hook.</td> </tr> <tr> <td data-bbox="305 1031 781 1058">$(0.0625 \times NLIU) < LVCS \leq (0.85 \times NLIU)$</td> <td data-bbox="808 1031 1317 1058">Report “LINE IN USE” and remain on-hook.</td> </tr> <tr> <td data-bbox="305 1062 565 1089">$(0.85 \times NLIU) < LVCS$</td> <td data-bbox="808 1062 1370 1089">Go off-hook and establish a modem connection.</td> </tr> </tbody> </table> <p>The NLIU register is updated every 1 ms with the minimum non-zero value of LVCS in the last 30 ms. This allows the Si2457/34/15/04 to eliminate errors due to 50/60 Hz interference and also adapt to relatively slow change in the on-hook dc reference value on the telephone line. This algorithm does not allow any non-zero values for NLIU below 0x0007. The host may also initialize NLIU prior to issuing the %V2 command. Once the call has begun, the off-hook intrusion algorithm (described in "4.12.2. Off-Hook Intrusion Detection" on page 18) operates normally. In addition, the Si2457/34/15/04 will report “NO LINE” if the telephone line is completely disconnected. If the HOI (U77, bit 11) bit is set, “LINE IN USE” is reported upon intrusion.</p> | <u>Loop Voltage</u> | <u>Action</u> | $0 \leq LVCS \leq (0.0625 \times NLIU)$ | Report “NO LINE” and remain on-hook. | $(0.0625 \times NLIU) < LVCS \leq (0.85 \times NLIU)$ | Report “LINE IN USE” and remain on-hook. | $(0.85 \times NLIU) < LVCS$ | Go off-hook and establish a modem connection. |
| <u>Loop Voltage</u> | <u>Action</u> | | | | | | | | |
| $0 \leq LVCS \leq (0.0625 \times NLIU)$ | Report “NO LINE” and remain on-hook. | | | | | | | | |
| $(0.0625 \times NLIU) < LVCS \leq (0.85 \times NLIU)$ | Report “LINE IN USE” and remain on-hook. | | | | | | | | |
| $(0.85 \times NLIU) < LVCS$ | Go off-hook and establish a modem connection. | | | | | | | | |



Table 13. Extended AT\ Command Set (Command Defaults in Bold)

| Command | Action |
|------------|--|
| \\$ | 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) |
| \Nn | Asynchronous protocol |
| \N0 | Wire mode (no error correction, no compression) |
| \N2 | MNP reliable mode. The Si2457/34/15/04 attempts to connect with the MNP protocol. If unsuccessful, the call is dropped. |
| \N3 | V.42 auto-reliable—The Si2457/34/15/04 attempts to connect with the V.42 protocol. If unsuccessful, the MNP protocol is attempted. If unsuccessful, wire mode is attempted. |
| \N4 | V.42 (LAPM) reliable mode (or drop call)—Same as \N3 except that the Si2457/34/15/04 drops the call instead of connecting in MNP or wire mode. |
| \N5 | V.42 and MNP reliable mode—The Si2457/34/15/04 attempts to connect with V.42. If unsuccessful, MNP is attempted. If MNP is unsuccessful, the call is dropped. |
| \Pn | Parity type will be automatically set in autobaud mode |
| \P0 | Even |
| \P1 | Space ¹ |
| \P2 | Odd |
| \P3 | Mark ¹ |
| \Qn | Modem-to-DTE flow control |
| \Q0 | Disable all flow control—This may only be used if the DTE speed and the VF speed are guaranteed to match throughout the call. |
| \Q2 | Use CTS only |

Notes:

1. When in autobaud mode, \B0, \B1, and \P1 will not be detected automatically. The combination of \B2 and \P3 will be detected. This is compatible with seven data bits, no parity, two stop bits. Seven data bits, no parity, one stop bit may be forced by sending AT\T17\B1.
2. The autobaud feature does not detect this rate.



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Table 13. Extended AT\ Command Set (Command Defaults in Bold) (Continued)

| Command | Action |
|-------------|--|
| \Q3 | Use RTS/CTS |
| \Q4 | Use XON/XOFF flow control for modem-to-DTE interface. Does not enable modem-to-modem flow control. |
| \Tn | DTE rate—Change DTE rate. When the Si2457/34/15/04 is configured in autobaud mode (default), \T0 through \T15 will lock the new baud rate and disable autobaud. On the 24-pin version, the ISO-modem® is not in autobaud mode (pin 18 low on powerup), the result code “OK” is sent at the old DTE rate. Subsequent commands must be sent at the new rate. |
| \T0 | 300 bps |
| \T1 | 600 bps |
| \T2 | 1200 bps |
| \T3 | 2400 bps |
| \T4 | 4800 bps |
| \T5 | 7200 bps |
| \T6 | 9600 bps |
| \T7 | 12.0 kbps ² |
| \T8 | 14.4 kbps |
| \T9 | 19.2 kbps |
| \T10 | 38.4 kbps |
| \T11 | 57.6 kbps |
| \T12 | 115.2 kbps |
| \T13 | 230.4 kbps |
| \T14 | 245.760 kbps ² |
| \T15 | 307.200 kbps |
| \T16 | Autobaud on³ |
| \T17 | Autobaud off; lock at current baud rate. |
| \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 RESET. |

Notes:

1. When in autobaud mode, \B0, \B1, and \P1 will not be detected automatically. The combination of \B2 and \P3 will be detected. This is compatible with seven data bits, no parity, two stop bits. Seven data bits, no parity, one stop bit may be forced by sending AT\T17\B1.
2. The autobaud feature does not detect this rate.



Table 13. Extended AT\ Command Set (Command Defaults in Bold) (Continued)

| Command | Action |
|----------------|--|
| \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. |

Notes:

1. When in autobaud mode, \B0, \B1, and \P1 will not be detected automatically. The combination of \B2 and \P3 will be detected. This is compatible with seven data bits, no parity, two stop bits. Seven data bits, no parity, one stop bit may be forced by sending AT\T17\B1.
2. The autobaud feature does not detect this rate.

Table 14. Result Codes

| 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 ¹ | | X | X | X | X | X |
| 12 | Link established at 9600 | CONNECT 9600 ¹ | | X | X | X | X | X |
| 14 | Link established at 19200 | CONNECT 19200 ¹ | | X | X | X | X | X |
| 15 | Link established at 7200 | CONNECT 7200 ¹ | | X | X | X | X | X |
| 16 | Link established at 12000 | CONNECT 12000 ¹ | | X | X | X | X | X |
| 17 | Link established at 14400 | CONNECT 14400 ¹ | | 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 ² | X | X | X | X | X | X |
| 40 | Blacklist is full | BLACKLIST FULL (enabled via S42 register) | X | X | X | X | X | X |
| 41 | Attempted number is black-listed. | BLACKLISTED (enabled via S42 register) | X | X | X | X | X | X |
| 42 | No phone line present | NO LINE (enabled via %Vn commands) | X | X | X | X | X | X |

Notes:

1. This message is only supported on the Si2457, Si2434, and Si2415.
2. This message is only supported on the Si2457 and Si2434.
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>.
4. This message is only supported on the Si2457.



Table 14. Result Codes (Continued)

| Numeric | Meaning | Verbal Response | X0 | X1 | X2 | X3 | X4 | X5 |
|---------|--------------------------------------|---|-----------------------|----|----|----|----|----|
| 43 | Telephone line is in use | LINE IN USE (enabled via %V\n 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 |
| 45 | A polarity reversal was NOT detected | NO POLARITY REVERSAL (enabled via G modifier) | X | X | X | X | X | X |
| 52 | Link established at 56000 | CONNECT 56000 ⁴ | | X | X | X | X | X |
| 60 | Link established at 32000 | CONNECT 32000 ⁴ | | X | X | X | X | X |
| 61 | Link established at 48000 | CONNECT 48000 ⁴ | | X | X | X | X | X |
| 63 | Link established at 28000 | CONNECT 28000 ⁴ | | X | X | X | X | X |
| 64 | Link established at 29333 | CONNECT 29333 ⁴ | | X | X | X | X | X |
| 65 | Link established at 30666 | CONNECT 30666 ⁴ | | X | X | X | X | X |
| 66 | Link established at 33333 | CONNECT 33333 ⁴ | | X | X | X | X | X |
| 67 | Link established at 34666 | CONNECT 34666 ⁴ | | X | X | X | X | X |
| 68 | Link established at 36000 | CONNECT 36000 ⁴ | | X | X | X | X | X |
| 69 | Link established at 37333 | CONNECT 37333 ⁴ | | X | X | X | X | X |
| 70 | No protocol | PROTOCOL: NONE | Set with \V0 command. | | | | | |
| 75 | Link established at 75 | CONNECT 75 | | X | X | X | X | X |
| 77 | V.42 protocol | PROTOCOL: V42 | Set with \V0 command. | | | | | |
| 79 | V.42bis protocol | PROTOCOL: V42bis | Set with \V0 command. | | | | | |
| 80 | MNP2 protocol | PROTOCOL: ALTERNATE, + CLASS 2 | Set with \V command. | | | | | |
| 81 | MNP3 protocol | PROTOCOL: ALTERNATE, + CLASS 3 | Set with \V command. | | | | | |
| 82 | MNP4 protocol | PROTOCOL: ALTERNATE, + CLASS 4 | Set with \V command. | | | | | |
| 83 | MNP5 protocol | PROTOCOL: ALTERNATE, + CLASS 5 | | X | X | X | X | X |
| 90 | Link established at 38666 | CONNECT 38666 ⁴ | | X | X | X | X | X |
| 91 | Link established at 40000 | CONNECT 40000 ⁴ | | X | X | X | X | X |
| 92 | Link established at 41333 | CONNECT 41333 ⁴ | | X | X | X | X | X |
| 93 | Link established at 42666 | CONNECT 42666 ⁴ | | X | X | X | X | X |
| 94 | Link established at 44000 | CONNECT 44000 ⁴ | | X | X | X | X | X |
| 95 | Link established at 45333 | CONNECT 45333 ⁴ | | X | X | X | X | X |
| 96 | Link established at 46666 | CONNECT 46666 ⁴ | | X | X | X | X | X |
| 97 | Link established at 49333 | CONNECT 49333 ⁴ | | X | X | X | X | X |
| 98 | Link established at 50666 | CONNECT 50666 ⁴ | | X | X | X | X | X |

Notes:

1. This message is only supported on the Si2457, Si2434, and Si2415.
2. This message is only supported on the Si2457 and Si2434.
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>.
4. This message is only supported on the Si2457.

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Table 14. Result Codes (Continued)

| Numeric | Meaning | Verbal Response | X0 | X1 | X2 | X3 | X4 | X5 |
|----------------|---|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| 99 | Link established at 52000 | CONNECT 52000 ⁴ | | X | X | X | X | X |
| 100 | Link established at 53333 | CONNECT 53333 ³ | | X | X | X | X | X |
| 101 | Link established at 54666 | CONNECT 54666 ³ | | 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. This message is only supported on the Si2457, Si2434, and Si2415.
2. This message is only supported on the Si2457 and Si2434.
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>.
4. This message is only supported on the Si2457.

The connect messages shown in Table 14 are sent when link negotiation is complete.



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 15 summarizes the S-register set.

Table 15. S-Register Description

| Definition | | | | |
|----------------------|---|-------------------|-------|-------------|
| S-Register (Decimal) | Function | Default (Decimal) | Range | Units |
| 0 | Automatic answer—Number of rings the Si2457/34/15/04 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 Si2457/34/15/04 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 Si2457/34/15/04 waits for carrier before timing out. This register also sets the number of seconds the modem waits for ringback 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 Si2457/34/15/04 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 Si2457/34/15/04 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 15. 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 | |
| 41 | V.34 symbol rate - Symbol rate for V.34 when using the &T4 and &T5 commands. 0 = 2400 symbols/second 1 = 2743 symbols/second 2 = 2800 symbols/second 3 = 3000 symbols/second 4 = 3200 symbols/second 5 = 3429 symbols/second A valid combination of symbol rate (S41) and data rate (&G) must be selected. <u>Symbol Rate</u> <u>Allowable Data Rates</u> 2400 2400–21600 2743 4800–26400 2800 4800–26400 3000 4800–28800 3200 4800–31200 3429 4800–33600 | 0 | 0–5 | |



Table 15. S-Register Description (Continued)

| Definition | | | | |
|-------------------------|---|----------------------|-------|---------|
| S-Register (Decimal) | Function | Default (Decimal) | Range | Units |
| 42 | Blacklisting—The Si2457/34/15/04 will not dial the same number more than two times in three minutes. An attempt to dial a third time within three minutes will result in a “BLACKLISTED” result code. If the blacklist memory is full, any dial to a new number will result in a “BLACKLIST FULL” result code. Numbers are added to the blacklist only if the modem connection fails. The %B command will list the numbers on the blacklists. 0 = disabled 1 = enabled | 0 (disabled) | 0–1 | |
| 43 | Dial Attempts to Blacklist. When blacklisting is enabled with S42, this value controls the number of dial attempts that will result in a number being blacklisted. | 4 | 0–4 | — |
| 44 | Blacklist Timer. Period during which blacklisting is active. | 180 | 0–255 | seconds |
| 50 | 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. | 3 | 0–255 | seconds |
| 51 | Number to start checking for an outside line on a PBX. See &X command for details. | 1 | 0–9 | — |

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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 16. 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. See "AN93: Modem Designer's Guide" for other country settings. | 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 16. 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. See "AN93: Modem Designer's Guide" for other country settings. | 0x0800 |
| U18 | BT1B1 | | 0x0000 |
| U19 | BT1B2 | | 0x0000 |
| U1A | BT1A2 | | 0x0000 |
| U1B | BT1A1 | | 0x0000 |
| U1C | BT2A0 | | Busy tone detect filter stage 2 biquad coefficients. |
| U1D | BT2B1 | 0x6EF1 | |
| U1E | BT2B2 | 0xC4F4 | |
| U1F | BT2A2 | 0xC000 | |
| U20 | BT2A1 | 0x0000 | |
| U21 | BT3A0 | Busy tone detect filter stage 3 biquad coefficients. | |
| U22 | BT3B1 | | 0x78B0 |
| U23 | BT3B2 | | 0xC305 |
| U24 | BT3A2 | | 0x4000 |
| U25 | BT3A1 | | 0xB50A |
| U26 | BT4A0 | | Busy tone detect filter stage 4 biquad coefficients. |
| U27 | BT4B1 | 0x70D2 | |
| U28 | BT4B2 | 0xC830 | |
| U29 | BT4A2 | 0x4000 | |
| U2A | BT4A1 | 0x80E2 | |
| U2B | BTK | Busy tone detect filter output scaler. | |
| 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. See "AN93: Modem Designer's Guide" for details. | 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 |



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Table 16. U-Register Description (Continued)

| Register | Name | Description | Default |
|----------|------|---|---------|
| U33 | RMOT | Ringback cadence minimum on time in seconds multiplied by 7200. | 0x1200 |
| 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 $RGFD = 2400 \text{ Hz} \times \left[\left(\frac{1}{\text{min ring freq (Hz)}} \right) - \left(\frac{1}{\text{max ring freq (Hz)}} \right) \right]$ | 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 Si2457/34/15/04 stays on-hook during this time. | 0x0000 |



Table 16. U-Register Description (Continued)

| Register | Name | Description | Default |
|----------|-------|---|---------|
| U4F | FHT | Flash Hook Time. Time corresponding with “!” or “&” dial modifier that the Si2457/34/15/04 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 |
| U53 | MOD2 | This is a bit-mapped register. | 0x0000 |
| U62 | DAAC1 | This is a bit-mapped register. | 0x0804 |
| U63 | DAAC3 | This is a bit-mapped register. | 0x0003 |
| U65 | DAAC4 | This is a bit-mapped register. | 0x00E0 |
| U66 | DAAC5 | This is a bit-mapped register. | 0xXX40 |
| 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. | 0xXX00 |
| U6E | CK1 | This is a bit-mapped register. | 0xXF20 |
| 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 |
| U79 | GEN4 | This is a bit-mapped register. | 0x00XX |
| U7A | GENA | 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 |
| U86 | V9AGG | V.90 rate adjustment for Japan (1333 BPS units). | 0x0000 |



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Table 16. U-Register Description (Continued)

| Register | Name | Description | Default |
|----------|---------|---|---------|
| U87 | SAM | This is a bit-mapped register | 0x0000 |
| U9F | SASF | SAS frequency detection. See “AN93: Modem Designer’s Guide” for complete details. | 0x0000 |
| UA0 | SC0 | SAS cadence 0. Sets the duration of the first SAS tone (ms). | 0x001E |
| 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 |
| UAA | V29MODE | This is a bit mapped register. | 0x0000 |



Table 17. 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 | | | | |
| U53 | MOD2 | REV | | | | | | | | | | | | | | | | |
| 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[7:0] | | | | | | | 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] | | | | | | | | | |
| U79 | GEN4 | | | | | | | | | | | LVCS[4:0] | | | | | | |
| U7A | GENA | | | | | | | | | DOP | ADD | | | | V22HD | HDLC | FAST | |
| U7C | GENC | | | | | | | | | | | | RIGPO | | | | RIG-POEN | |
| U7D | GEND | | NLM | | | | | | | | | | | | | ATZD | FDP | |
| U87 | SAM | | | | | | MINT | SERM | FSMS | XMTT | | | | | | | | |
| UAA | V29MODE | | | | | | | | | | | | | | | V29ENA | | |



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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. |



U53 MOD2

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

Reset settings = 0x0000

| Bit | Name | Function |
|------|----------|---|
| 15 | REV | V.23 Reversing. 0 = Disable. 1 = Enable. |
| 14:0 | Reserved | Read returns zero. |

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. OHS OHS2Mean On-Hook Speed 0 0 Less than 0.5 ms 0 1 3 ms ±10% (meets ETSI standard) 1 X26 ms ±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. Clear after test is terminated. |
| 0 | Reserved | Must be set to 0. |



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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 Si2457/34/15/04 and Si3018. Once set to 1, the Si2457/34/15/04 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.



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 = 0xXX40

| Bit | Name | Function |
|--|----------|---|
| 15:7 | Reserved | Do not modify. |
| 6 | FDT* | Frame Detect. 0 = Indicates ISModem has not established frame lock. 1 = Indicates ISModem frame lock has been established. |
| 5:0 | Reserved | Read returns zero. |
| *Note: Typically used only for board-level debug. | | |

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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 | |

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 | | | | | | | | | | | | | |



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| 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. See the “Ringer Impedance” section in “AN93: Modem Designer’s Guide”. |
| 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. |



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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. See the "Billing Tone Detection" section in "AN93: Modem Designer's Guide". 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 = 0xXX40

| Bit | Name | Function |
|------|----------|--|
| 15:8 | LVS[7:0] | Line Voltage Status. Eight bit signed, two's 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. |



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 = 0xFF20

| Bit | Name | Function |
|-------|----------|--|
| 15:13 | Reserved | Do not modify. |
| 12:8 | R1[4:0] | R1 CLKOUT Divider. See "AN93: Modem Designer's Guide" for details. |
| 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. See "AN93: Modem Designer's Guide" for details. |

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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 Si2457/34/15/04 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). |



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 LVCS. 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 LVCS 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 LVCS 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 LVCS before an intrusion and before going on-hook (default = 0). |

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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 LVCS is checked for overcurrent condition after going off-hook (30 ms default). |



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 = 0x00XX

| 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> |

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U79 GEN4

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

Reset settings = 0x0000

| Bit | Name | Function |
|------|-----------|--|
| 15:5 | Reserved | Read returns zero. |
| 4:0 | LVCS[4:0] | <p>Line Voltage Current Sense. Represents either the line voltage, loop current, or on-hook line monitor. On-Hook Voltage Monitor (2.75 V/bit ±20%). 00000 = No line connected. 00001 = Minimum line voltage ($V_{MIN} = 3.0\text{ V} \pm 0.5\text{ V}$). 11111 = Maximum line voltage ($87\text{ V} \pm 20\%$). The line voltage monitor full scale may be modified by changing R5 as follows: $V_{MAX} = V_{MIN} + 4.2 (10M + R5 + 1.6k)/(R5 + 1.6k)/5$</p> <p>Off-Hook Loop Current Monitor (3 mA/bit). 00000 = No loop current. 00001 = Minimum loop current. 11110 = Maximum loop current. 11111 = Loop current is excessive (overload). Overload > 140 mA in all modes except TBR21 Overload > 54 mA in TBR21 mode</p> <p>LVCS is backward compatible with Si2456/33/14 ISModems. The LVCS value is absolute and does not reflect loop polarity. See U6C (LVS)[15:8] for 1 V/bit resolution and signed twos complement output</p> |



U7A GENA

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|-----|-----|-----|-----|-----|-----|----|----|-----|-----|----|----|----|-------|------|------|
| Name | | | | | | | | | DOP | ADD | | | | V22HD | HDLC | FAST |
| Type | | | | | | | | | R/W | R/W | | | | R/W | 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 Si2457/34/15/04 will redial the first digit and remaining digits as pulse. If a dialtone is not present after two seconds, the Si2457/34/15/04 will dial the remaining digits as DTMF. |
| 5:3 | Reserved | Read returns to zero. |
| 2 | V22HD | V.22bis Synchronous Mode.* 0 = Normal asynchronous mode. 1 = Transparent HDLC mode. |
| 1 | HDLC | Synchronous Mode.* 0 = Normal asynchronous mode. 1 = Transparent HDLC mode. |
| 0 | FAST | Fast Connect.* 0 = Normal modem handshake timing per ITU/Bellcore standards. 1 = Fast connect modem handshake timing. |
| *Note: When V22HD, HDLC, or FAST bits are set, \N0 (wire mode) must be used. | | |



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U7C GENC

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

Reset settings = 0x0000

| Bit | Name | Function |
|------|----------|--|
| 15:5 | Reserved | Reads returns to zero. |
| 4 | RIGPO | $\overline{\text{RI}}$ RI follows this bit when RIGPIOEN = 1 _b . |
| 3:1 | Reserved | Reads returns to zero. |
| 0 | RIGPOEN | 0 = $\overline{\text{RI}}$ indicates valid ring signal. (Normal ring-indicator mode) 1 = $\overline{\text{RI}}$ 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 | Minimal Transparency 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. 1 = Generates one-byte transparency sequences. This option will only use codes <T1> through <T4> for received data. |
| 9 | SERM | Special Error Reporting Mode 0 = Ignore unrecognized in-band commands. 1 = Generate <0x45> ("E" for error) in response to any unrecognized in-band commands. |
| 8 | FSMS | Framed Sub-Mode Startup 0 = Upon successful connection, enter Transport Sub-Mode. An <FLAG> is required to enter Framed Sub-Mode. 1 = Upon successful connection, immediately enter Framed Sub-Mode. The first received <err> from a successful hunt is transformed into an <flag>. |
| 7:0 | XMTT[7:0] | Transmitter Threshold This value represents the number of bytes before a transmission is started. The following values are special: 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. 255 The same as infinity, e.g. never start a packet until the closing flag is received. |

UAA V.29 Mode

| Bit | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|--------|----|
| Name | | | | | | | | | | | | | | | V29ENA | |
| Type | R/W | | | | | | | | | | | | | | | |

Reset settings = 0x0000

| Bit | Name | Function |
|------|----------|---|
| 15:2 | Reserved | Reads returns to zero. |
| 1 | V29ENA | 0 = Disables V.29. 1 = Enables V.29. |
| 0 | Reserved | Read returns zero. |



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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. |



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 |

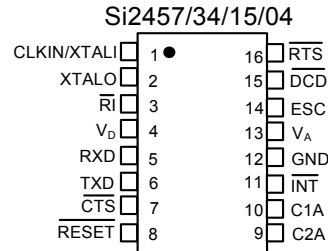
Reset settings = 0110_0011

| Bit | Name | Function |
|-----|-------------------------|--|
| 7 | RXF | <p>Receive FIFO Almost Full (status). 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. 1 = Receive FIFO contains two or less empty locations ($\text{RXF} \geq 10$).</p> |
| 6 | TXE | <p>Transmit FIFO Almost Empty (status). 0 = Transmit FIFO (14 deep) contains three or more characters ($\text{TXF} \geq 3$). 1 = Transmit FIFO contains two or less characters ($\text{TXF} \leq 2$). 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. 0 = Receive FIFO has valid data. 1 = Receive FIFO empty. 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. 0 = In parallel mode, the $\overline{\text{INT}}$ pin is triggered by a rising edge on RXF or TXE only (default). 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. 0 = No interrupt has occurred. 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. 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. Operation of this bit in parallel mode is functionally equivalent to the $\overline{\text{RTS}}$ pin in serial mode. Use of the CTS and RTS bits (as opposed to the TXE and RXF bits) allows the flow control between the host and the ISOmodem® to operate 1 byte at a time, rather than in blocks.</p> |
| 0 | $\overline{\text{CTS}}$ | <p>Clear-to-Send. 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 ISOmodem to operate 1 byte at a time, rather than in blocks.</p> |



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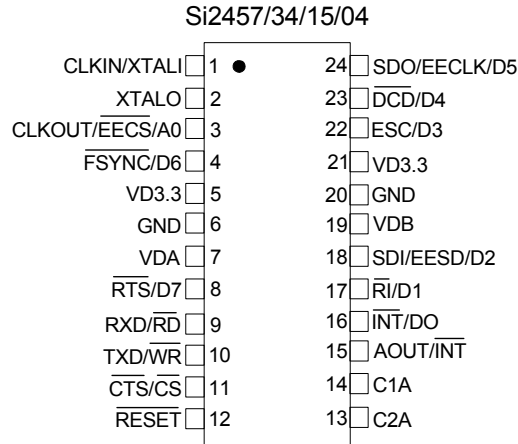
8. Pin Descriptions: Si2457/34/15/04 (16-Pin Option)



| Pin # | Pin Name | Description |
|-------|----------------|--|
| 1 | CLKIN/XTALI | XTALI—Crystal Oscillator Pin. Provides support for parallel resonant AT cut crystals. A 4.9152 MHz crystal or a 4.9152 or 27 MHz clock on XTALI is required. |
| 2 | XTALO | XTALO—Crystal Oscillator Pin. Serves as the output of the crystal amplifier. |
| 3 | RI | Ring Indicator. The RI on (active low) indicates the presence of an ON segment of a ring signal on the telephone line. |
| 4 | V _D | Supply Voltage. Provides the 3.3 V supply voltage to the Si2457/34/15/04. |
| 5 | RXD | Receive Data. Data output to DTE RXD pin. |
| 6 | TXD | Transmit Data. Data input from DTE TXD pin. |
| 7 | CTS | Clear to Send. Signals that the Si2457/34/15/04 is ready to receive more digital data on the TXD pin. |
| 8 | RESET | Reset Input. An active low input that is used to reset all control registers to a defined, initialized state. |
| 9 | C2A | Isolation Capacitor 2A. Connects to one side of the isolation capacitor C2. |
| 10 | C1A | Isolation Capacitor 1A. Connects to one side of the isolation capacitor C1. |
| 11 | INT | Interrupt Output. Active low interrupt output. |
| 12 | GND | Ground. Connects to the system digital ground. |
| 13 | V _A | Regulator Voltage Reference. Connects to an external capacitor and serves as the reference for the internal voltage regulator. |
| 14 | ESC | Escape. A positive edge on this pin causes the modem to go from online (connected) mode to the offline (command) mode. |
| 15 | DCD | Carrier Detect. Active low carrier detect. |
| 16 | RTS | Request to Send. Active low request to send input used for flow control. |



9. Pin Descriptions: Si2457/34/15/04 (24-Pin Option)



| Pin # | Pin Name | Description |
|-------|----------------|--|
| 1 | CLKIN/XTALI | Clock Input/Crystal Oscillator Pin. Provides support for parallel resonant AT cut crystals. A 4.9152 MHz crystal or a 4.9152 or 27 MHz clock on XTALI is required. |
| 2 | XTALO | Crystal Oscillator Pin. Serves as the output of the crystal amplifier. |
| 3 | CLKOUT/EECS/A0 | Clock Output/EEPROM Chip Select/Address Bit 0. Clock output in serial mode. Active low read/write enable for SPI EEPROM in serial mode when pin 4 is pulled low during powerup. 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 supply voltage to the Si2457/34/15/04. |
| 6, 20 | GND | Ground. Connects to the system digital ground. |
| 7, 19 | VDA, VDB | Regulator Voltage Reference. Connects to an external capacitor and serves as the reference for the internal voltage regulator. |
| 8 | RTS/D7 | Request to Send/Data Bit. Active low request to send input used 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. |



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| Pin # | Pin Name | Description |
|-------|--------------------------------|---|
| 10 | TXD/ \overline{WR} | Transmit Data/Write Enable. Data input from DTE TXD pin in serial mode. Active low write enable pin in parallel mode. |
| 11 | $\overline{CTS}/\overline{CS}$ | Clear to Send/Chip Select. Signals that the Si2457/34/15/04 is ready to receive morre digital data on the TXD pin in data mode. Active low chip select in parallel mode. |
| 12 | \overline{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{INT} | Analog Output/Interrupt Output. Analog output in serial mode. Active low interrupt output in parallel mode. |
| 16 | $\overline{INT}/D0$ | Interrupt Output/Data Bit. Active low interrupt output in serial mode. Bidirectional parallel bus data bit 0 in parallel mode. |
| 17 | $\overline{RI}/D1$ | Ring Indicator/Data Bit. The \overline{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/EESD/D2 | Serial Data In/EEPROM Serial Data Input/Output/Data Bit. Serial Data In (to codec) output in serial mode. Bidirectional Input/Output to SPI EEPROM in serial mode when pin 4 is pulled low during power up. 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 | $\overline{DCD}/D4$ | Carrier Detect/Data Bit. Active low carrier detect in serial mode. Bidirectional parallel bus data bit 4 in parallel mode. |
| 24 | SDO/EECLK/D5 | Serial Data Out/EEPROM Clock/Data Bit 5. Serial Data Out (from codec) input in serial mode. Clock output for SPI EEPROM in serial mode when pin 4 is pulled low during power up. Bidirectional parallel bus data bit 5 in parallel mode. |



10. Pin Descriptions: Si3018/10

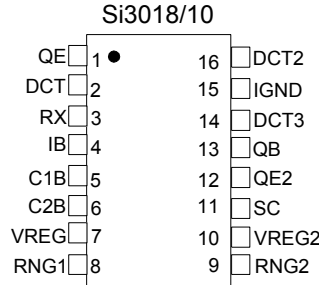


Table 18. Si3018 Pin Descriptions

| 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 system side. |
| 6 | C2B | Isolation Capacitor 2B. Connects to one side of isolation capacitor C2 and communicates with the system side. |
| 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 Si2457/34/15/04. |
| 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 Si2457/34/15/04. |
| 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. |



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11. Ordering Guide

| Chipset | Max Speed | Digital Package | Digital | Line | Temp Range |
|---------|-----------|-----------------|-------------|-----------|------------|
| Si2457 | 56 kbps | 24-pin TSSOP | Si2457-X-FT | Si3018-FS | 0 to 70 °C |
| Si2457 | 56 kbps | 16-pin SOIC | Si2457-X-FS | Si3018-FS | 0 to 70 °C |
| Si2434 | 33.6 kbps | 24-pin TSSOP | Si2434-X-FT | Si3018-FS | 0 to 70 °C |
| Si2434 | 33.6 kbps | 16-pin SOIC | Si2434-X-FS | Si3018-FS | 0 to 70 °C |
| Si2415 | 14.4 kbps | 24-pin TSSOP | Si2415-X-FT | Si3018-FS | 0 to 70 °C |
| Si2415 | 14.4 kbps | 16-pin SOIC | Si2415-X-FS | Si3018-FS | 0 to 70 °C |
| Si2404 | 2400 bps | 24-pin TSSOP | Si2404-X-FT | Si3010-FS | 0 to 70 °C |
| Si2404 | 2400 bps | 16-pin SOIC | Si2404-X-FS | Si3010-FS | 0 to 70 °C |

Notes:

1. Add an "R" at the end of the device to denote tape and reel option; 2500 quantity per reel.
2. "X" denotes product revision.



12. Package Outline: 24-Pin TSSOP

Figure 9 illustrates the package details for the Si2457/34/15/04 24-pin packaging option. Table 19 lists the values for the dimensions shown in the illustration.

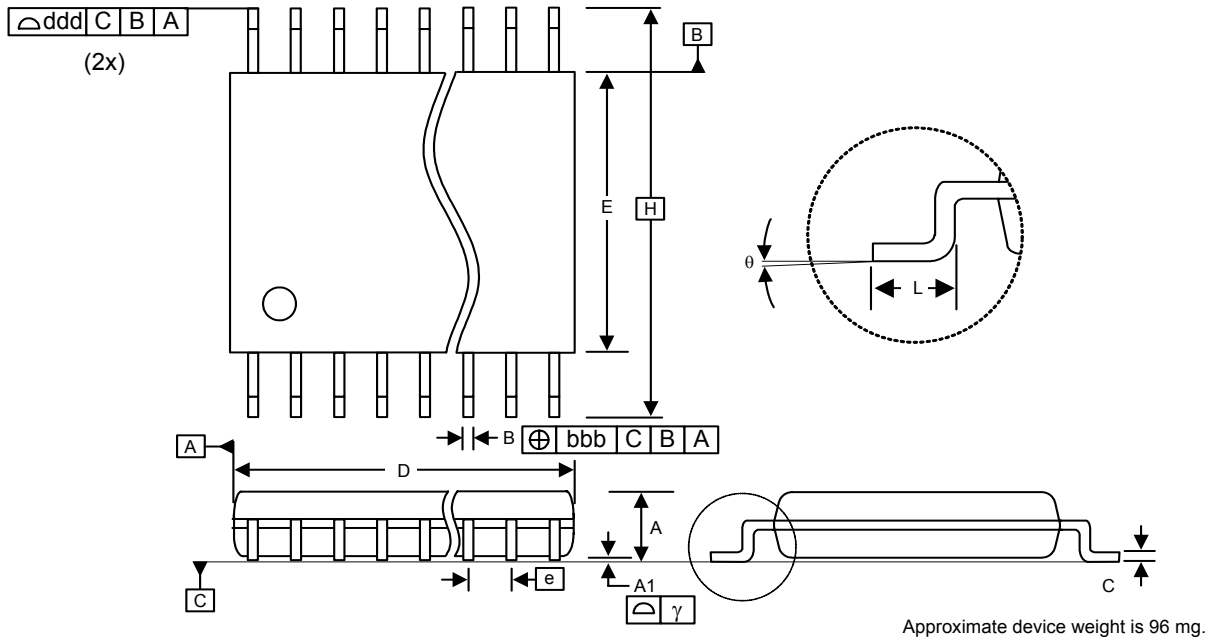


Figure 9. 24-Pin Thin Shrink Small Outline Package (TSSOP)

Table 19. 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 | |

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13. Package Outline: 16-Pin SOIC

Figure 10 illustrates the package details for the Si3018/10 and the Si2457/34/15/04 16-pin packaging option. Table 20 lists the values for the dimensions shown in the illustration.

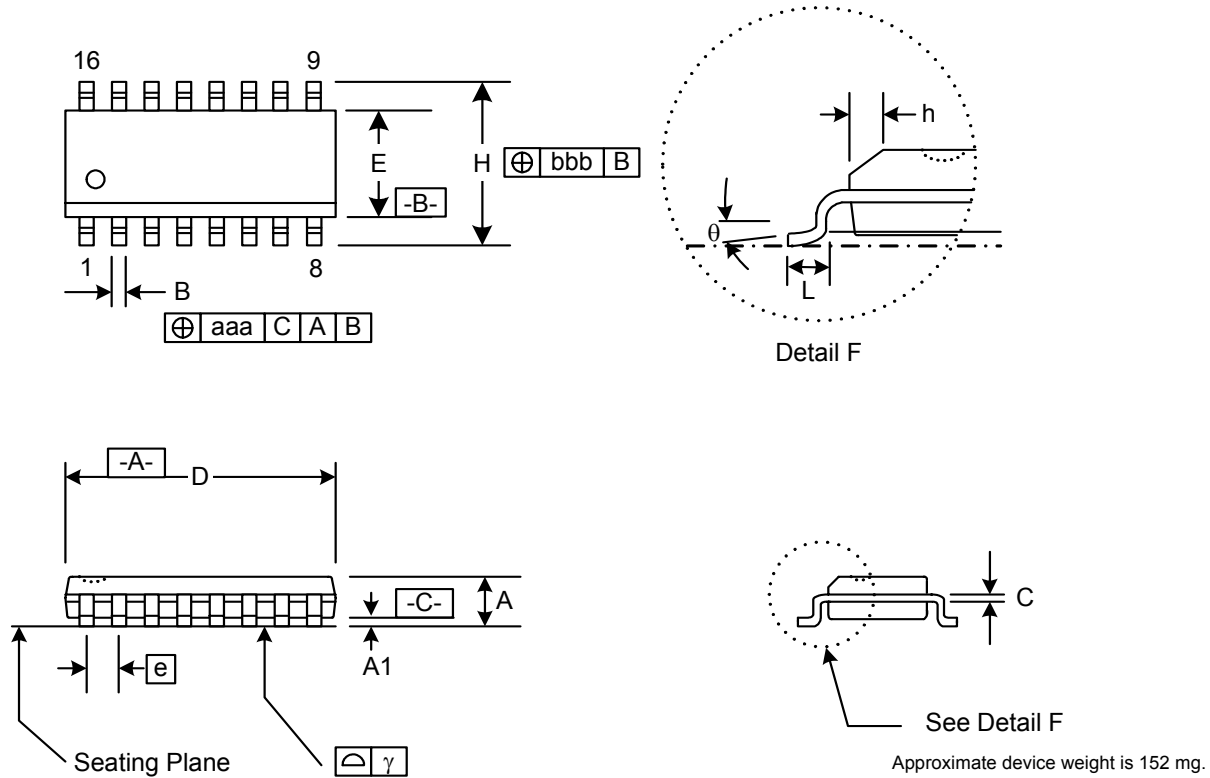


Figure 10. 16-pin Small Outline Integrated Circuit (SOIC) Package

Table 20. 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 | |



DOCUMENT CHANGE LIST

Revision 0.91 to Revision 1.0

- Added Figure 5 typical schematic with 16-pin system-side option.
- Updated Table 3 to include 16-pin system-side parameters.
- Updated default register setting in Table 16.
- Added Si2404 information.
- Added 16-pin system-side option.
- Updated "4. Functional Description" on page 16.
- Added "8. Pin Descriptions: Si2457/34/15/04 (16-Pin Option)" on page 66.
- Updated "11. Ordering Guide" on page 70 to reflect part revision.

Si2457/34/15/04

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