TELEGRAM LISTING STANDARD

S3000 Standard, Advanced, Professional, Remote
S300 Standard, Advanced, Professional

Safety Laser Scanner

de

en

SICK
Sensor Intelligence.

Inhalt

1 Zu diesem Dokument

Bitte lesen Sie dieses Kapitel sorgfältig, bevor Sie mit der Dokumentation und der Messdatenausgabe des S3000 oder S300 arbeiten.

1.1 Funktion dieses Dokuments

Das vorliegende Telegrammlisting Standard beschreibt die messdatenspezifische Funktionserweiterung des S3000 Standard/Advanced/Professional/Remote und des S300 Standard/Advanced/Professional (genauer Geltungsbereich siehe Abschnitt 1.4 „Geltungsbereich“ auf S. 5).
Es ist als Ergänzung zur Betriebsanleitung S3000 bzw. S300 zu verstehen.

ACHTUNG

Für allgemeine Informationen, wie beispielsweise zum Anbau, zur Installation und Inbetriebnahme des Sicherheits-Laserscanners, verwenden Sie bitte die Betriebsanleitung S3000 bzw. S300. Beachten Sie bitte die darin beschriebenen Sicherheitshinweise in Kapitel 2 und 8, bevor Sie die Anlage in Betrieb nehmen.

Die vom Laserscanner zur Verfügung gestellten Telegrammdaten dürfen nicht für Sicherheitsanwendungen verwendet werden!

1.2 Zielgruppe

Das Telegrammlisting Standard richtet sich an Systemspezialisten im Bereich der Hard- und Softwareentwicklung, die die scannereigenen Messwertdaten in ihre Hostapplikation einbinden und auswerten wollen.

1.3 Informationstiefe

Das vorliegende Telegrammlisting Standard enthält Informationen zu folgenden Themen:

- Beschreibung der RS-422-Schnittstelle
- Beschreibung des verwendeten RK512-Protokolls
- Beschreibung der scannerspezifischen Sonderfunktionen
- Hinweise zum Einsatz
- Fehlerdiagnose

1.4 Geltungsbereich

Das vorliegende Telegrammlisting ist anwendbar für den Laserscanner S3000 Standard/Advanced/Professional/Remote und für den Laserscanner S300 Standard/Advanced/Professional mit folgenden Typenbezeichnungen:

S3000: S30**A**-XXXX X**A**

S300: S30**B**-XXXX X**A**

Hinweis Die Laserscanner S300 Standard und S300 Advanced unterstützen die Messdatenausgabe nur, wenn sie mit einem Systemstecker mit einer Seriennummer ≥ 12210000 ausgestattet sind. Für Geräte mit älterem Systemstecker ist das Telegrammlisting daher nicht anwendbar.

2 Systembeschreibung

2.1 Datenausgabe

Die Sicherheits-Laserscanner S3000 Standard/Advanced/Professional/Remote und S300 Standard/Advanced/Professional können über die RS-422-Schnittstelle Messdaten ausgeben.

Diese Daten können für allgemeine Überwachungs- und Steuerungsaufgaben verwendet werden. Sie dienen insbesondere der Navigationsunterstützung bei fahrerlosen Transportfahrzeugen (FTF).

ACHTUNG

Die vom Laserscanner zur Verfügung gestellten Telegrammdaten dürfen nicht für Sicherheitsanwendungen verwendet werden!

Hinweis Wenn Sie die erweiterten CMS-Funktionen verwenden, dann sollten Sie im Fall eines Geräteaustauschs als Ersatz für ein CMS-Gerät immer ein CMS-Gerät verwenden.

Die Konfiguration der Messdatenausgabe erfolgt zusammen mit der Konfiguration des Scanners über eine der Kommunikationsschnittstellen (RS-232, RS-422, EFI).

Die Daten werden während des Betriebs von einem Hostrechner über die RS-422-Schnittstelle empfangen und verarbeitet. Die Datenübertragung erfolgt in der Form von Telegrammen nach dem RK512-Protokoll.

Die Datenausgabe erfolgt je nach Konfiguration auf unterschiedliche Weise:

- Die Datentelegramme werden vom Hostrechner einzeln angefordert (Sendemodus *Datenausgabe nur auf Anfrage*).
- Die Datentelegramme werden vom Sicherheits-Laserscanner kontinuierlich ausgegeben (Sendemodus *Kontinuierliche Datenausgabe*).

2.1.1 Kompatibilitätsmodus

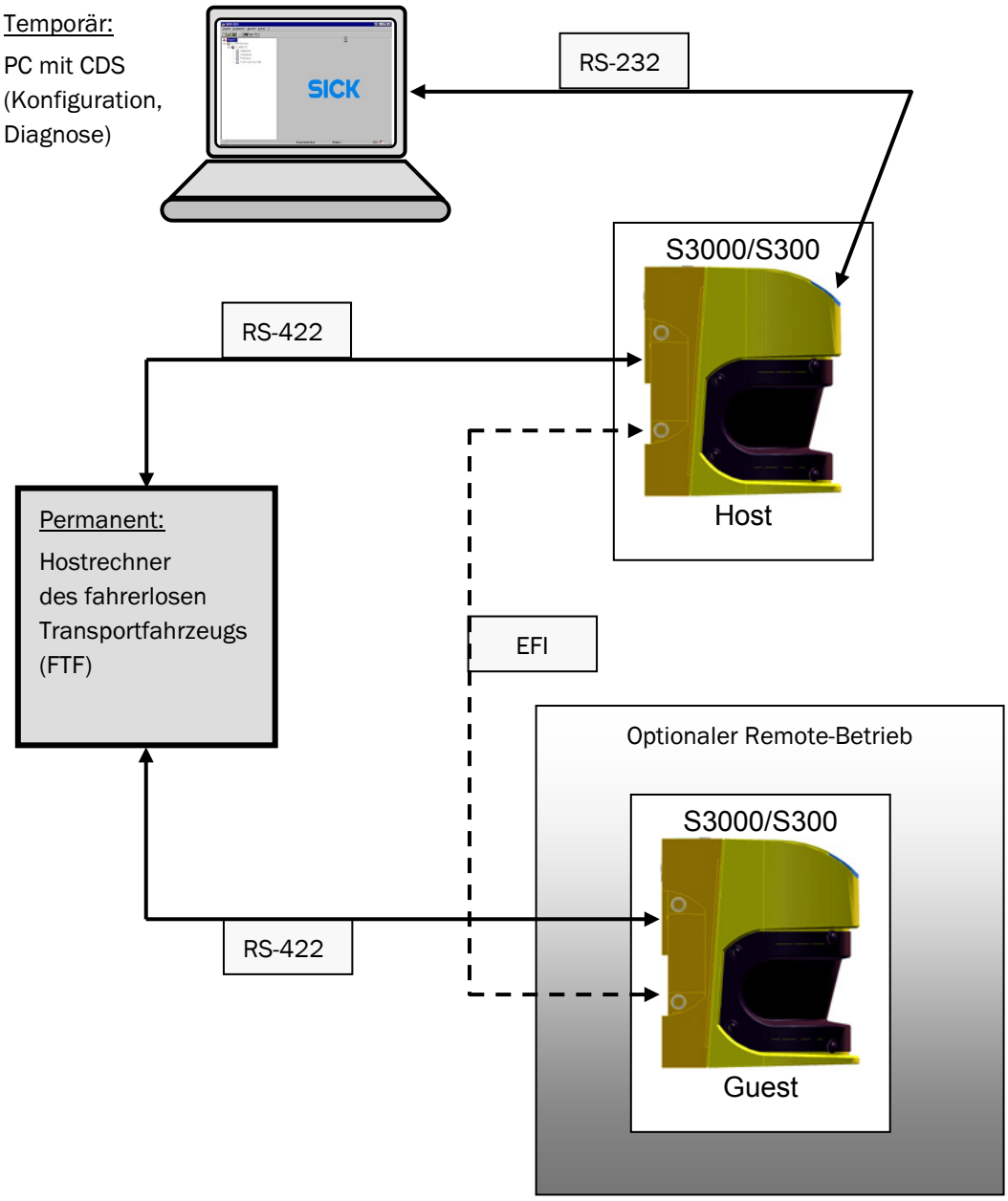
Um die Kompatibilität mit älteren Geräten zu gewährleisten, können die Sicherheits-Laserscanner S3000 mit Firmware ≥ B02.40 und die Sicherheits-Laserscanner S300 mit Firmware ≥ 02.10 im Kompatibilitätsmodus betrieben werden. Den Kompatibilitätsmodus aktivieren Sie im Geräteauswahlassistenten der CDS (SICK Configuration & Diagnostic Software).

Die Messdatenausgabe des S3000 im Kompatibilitätsmodus ist identisch mit der des S3000 mit Firmware < B02.40; die Messdatenausgabe des S300 Expert im Kompatibilitätsmodus ist identisch mit der des S300 mit Firmware < 02.10.

Weitere Informationen zum Kompatibilitätsmodus finden Sie in der Betriebsanleitung zum S3000/S300 (Art.-Nr. 8009937/8010947).

Sofern für den Kompatibilitätsmodus abweichende Einstellungen oder Ausgaben gelten, wird in diesem Dokument darauf hingewiesen.

2.2 Systemaufbau



2.3 Elektrische Schnittstelle

Die elektrische Schnittstelle ist nach dem Standard EIA RS-422-A implementiert.

Die elektrische Anschlussmöglichkeit finden Sie in der Betriebsanleitung S3000/S300 im Kapitel „Elektroinstallation“.

Der Anschluss über die RS-422-Schnittstelle darf im laufenden Betrieb bestehen. Die RS-232-Schnittstelle (Konfigurationsschnitstelle) ist dagegen ausschließlich für den temporären Anschluss während der Konfiguration vorgesehen.

2.3.1 Übertragungs- und Datenformat

Ein Datenbyte setzt sich zusammen aus 1 Startbit, 8 Datenbits, 1 Stopbit, kein Paritybit.

Die Baudrate an der RS-422-Schnittstelle ist mit Hilfe der CDS einstellbar auf folgende Baudraten:

- 9600 Baud
- 19200 Baud
- 38400 Baud
- 115,2 kBaud (nur S300)
- 125 kBaud
- 230,4 kBaud (nur S300)
- 250 kBaud
- 460,8 kBaud (nur S300)
- 500 kBaud

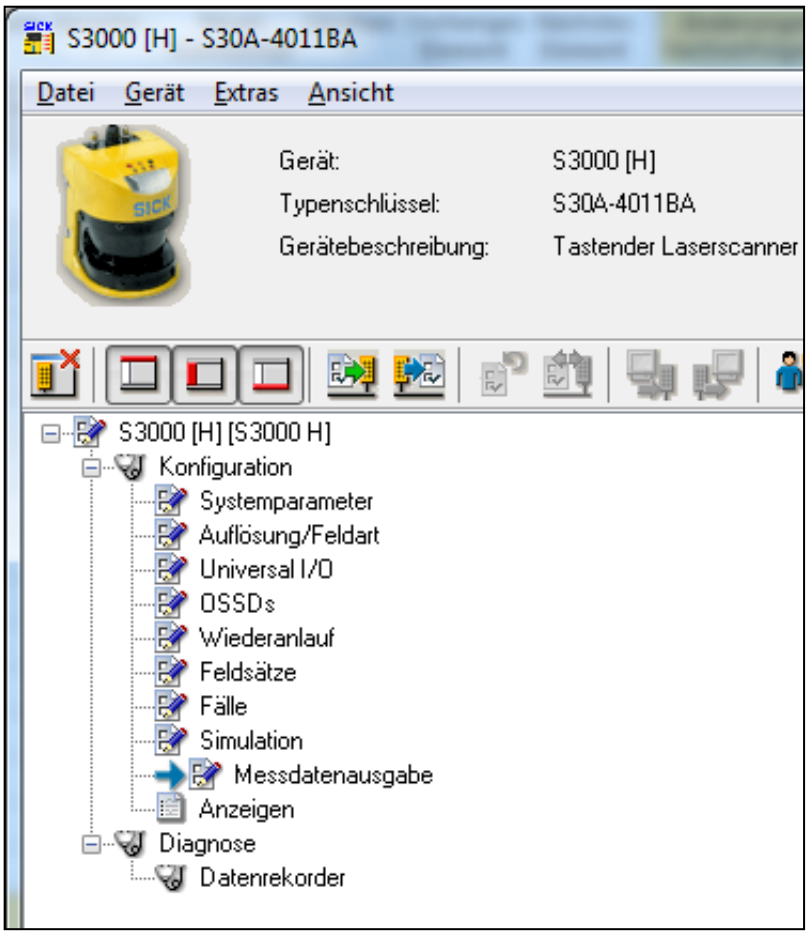
Im Auslieferungszustand ist die Schnittstelle mit einer Baudrate von 38400 Baud vorkonfiguriert.

Beim S3000 können alle Messdaten in (Beinahe-)Echtzeit (mit einer Verzögerung von ca. einer Spiegelumdrehung, d. h. je nach Modus 30 ms oder 60 ms) übertragen werden, wenn die Schnittstelle auf 500 kBaud eingestellt ist. Bei niedrigeren Baudraten oder hoher Netzauslastung kann nicht jeder Scan ausgewertet werden, so dass die Daten einzelner oder mehrerer Messungen entfallen und nur die Daten jeder zweiten, dritten etc. Messung ausgegeben werden.

Beim S300 können die Messdaten jeder zweiten Messung in Echtzeit übertragen werden, wenn die Schnittstelle auf 500 kBaud eingestellt ist. Bei niedrigeren Baudraten oder hoher Netzauslastung werden weniger Scans ausgewertet, so dass die Daten einzelner oder mehrerer Messungen entfallen und nur die Daten jeder dritten, vierten etc. Messung ausgegeben werden.

3 Konfiguration der Messdatenausgabe

3.1 CDS-Bedienoberfläche



Hinweis Die Abbildungen der Bedienoberfläche in diesem Kapitel sind beispielhaft. Das tatsächliche Aussehen der Bedienoberfläche kann je nach Softwareversion, Gerät und Feldmodus abweichen.

Die Konfiguration der Messdatenausgabe erfolgt in der CDS über das Gerätesymbol *S3000* bzw. *S300* im Bereich *Messdatenausgabe*.

3.2 Grundeinstellungen

3.2.1 Baudrate

Die Baudrate der RS-422-Schnittstelle lässt sich entsprechend der Menüauswahl einstellen (weitere Informationen siehe Abschnitt 2.3.1 „Übertragungs- und Datenformat“ auf Seite 8).

3.2.2 Silentzeit individuell

Die Silentzeit dient dazu, im Sendemodus *Kontinuierliche Datenausgabe* die Schnittstelle freizugeben. Dazu kann der Hostrechner die Datenausgabe für die eingestellte Silentzeit unterbrechen (siehe Abschnitt 6.5 „Anhalten der Datenausgabe“ auf Seite 25). Anschließend ist der Zugriff auf die Schnittstelle möglich. Nach Ablauf der Silentzeit wird die Datenausgabe automatisch fortgesetzt

Im Auslieferungszustand ist die Silentzeit auf 5000 ms eingestellt.

3.2.3 Sendemodus

Datenausgabe nur auf Anfrage:	Daten werden nur auf Anfrage ausgegeben (siehe Kapitel 5 „Sendemodus *Datenausgabe nur auf Anfrage*“ auf S. 14).
Kontinuierliche Datenausgabe:	Daten werden permanent ausgegeben (siehe Kapitel 6 „Sendemodus *Kontinuierliche Datenausgabe*“ auf S. 20).

4 Kommunikationsarten

4.1 Geräte-Adressen

Für eine Kommunikation der Geräte im Remote-Betrieb sind die Kommunikationsadressen (Device Address) für Host und Guest notwendig.

Für einzelne Scanner ist die Geräteadresse 0x07.

Wenn zwei Scanner im Verbund betrieben werden, sind die Adressen wie folgt aufgeteilt:

- Host: 0x07
- Guest: 0x08

Diese Adresse wird im RK512-Telegrammkopf als Device Address angegeben (siehe Abschnitt 5.1 „Command-Telegramm“ auf Seite 14).

4.2 System-Token

Das Token verwaltet die unterschiedlichen Kommunikationsportale (RS-232, RS-422, EFI). Ein Gerät erlaubt keinen zeitgleichen Zugriff von verschiedenen Schnittstellen. In einem EFI-Verbund gilt dies für alle Schnittstellen der beteiligten Geräte: Der Zugriff kann immer nur über eine einzelne Schnittstelle erfolgen. Dies wird dadurch sichergestellt, dass vor dem Lesen oder Schreiben der Daten das Token angefordert und erfolgreich zugewiesen werden muss.

Falls auf der Messdatenschnittstelle (RS-422) kontinuierliche Datenausgabe erfolgt, kann gleichzeitig über die Konfigurationsschnittstelle (RS-232) oder EFI eine Kommunikation durchgeführt werden. Die kontinuierliche Datenausgabe wird dadurch nicht beeinflusst.

Ausnahme:

Im Sendemodus *Kontinuierliche Datenausgabe* kann nicht direkt ein Request-Telegramm vom Hostrechner gesendet werden. Der Hostrechner muss zuerst die kontinuierliche Datenausgabe unterbrechen (siehe Abschnitt 6.5 „Anhalten der Datenausgabe“ auf S. 25).

Von einer seriellen Schnittstelle muss immer das angeschlossene Gerät adressiert werden, um das Token zu erhalten. Ohne vorherige Zuweisung des Token ist es nicht möglich, auf Daten eines Geräts zuzugreifen. Das Token wird beim Ausschalten nicht gespeichert und muss nach dem Einschalten neu angefordert werden.

Sie fordern das Token an, indem Sie mit einem Send-Telegramm z. B. für den Zugriff auf einen einzelnen Scanner (ohne EFI-Verbund) über die RS-232-Schnittstelle den Wert 0x0F07 in Block 25 schreiben.

Sie geben das Token frei, indem Sie mit einem Send-Telegramm den Wert 0x0000 in Block 25 schreiben.

Ein Beispiel für die Kommunikation inklusive Schreiben und Freigeben des Token finden Sie in Abschnitt 5.4.1 „Beispiel für Kommunikation im Sendemodus *Datenausgabe nur auf Anfrage*“ auf S. 18.

Detaillierte Informationen zum Datenformat finden Sie im Appendix in Abschnitt 10.1.3 „Config master block (block no. 25)“ auf S. 61 für den S3000 und in Abschnitt 10.2.3 „Config master block (block no. 25)“ auf S. 79 für den S300.

4.3 Telegrammstruktur

Die Kommunikation nach dem RK512-Standard basiert auf Command- und Reply-Telegrammen. Ein Command-Telegramm ist entweder ein Send- oder ein Fetch-Telegramm. Auf dieser Kommunikationsstruktur beruht der Sendemodus *Datenausgabe nur auf Anfrage*: Der Hostrechner sendet ein Fetch-Telegramm an den Scanner, um die Messdaten abzurufen. Der Scanner sendet die angeforderten Daten in einem Reply-Telegramm. Detaillierte Informationen zur Struktur der Command- und Reply-Telegramme finden Sie in Kapitel 5 „Sendemodus *Datenausgabe nur auf Anfrage*“ auf Seite 14.

Im Sendemodus *Kontinuierliche Datenausgabe* werden die Daten vom Scanner ebenfalls in Telegrammen übertragen. Es erfolgt keine Anforderung durch den Hostrechner (detaillierte Informationen in Kapitel 6 „Sendemodus *Kontinuierliche Datenausgabe*“ auf Seite 20). Bei Bedarf kann die kontinuierliche Datenausgabe unterbrochen werden, um Command-Telegramme an den Scanner zu senden (siehe Abschnitt 6.5 „Anhalten der Datenausgabe“ auf Seite 25).

Im Telegrammkopf werden Werte, die 2 Byte umfassen, mit dem High Byte (HB) zuerst übertragen. Bei den Datenbytes werden die 16- und 32-bit-Wörter mit dem Low Byte (LB) zuerst übertragen.

Der Wert im Size-Feld bezeichnet immer die Anzahl von 16-bit-Datenwörtern, es kann nicht auf einzelne Bytes zugegriffen werden.

4.4 Datenintegrität

Da der RK512-Standard keinen Mechanismus zur Überprüfung der Integrität der empfangenen Daten zur Verfügung stellt, ist ein solcher Mechanismus in den Daten des RK512-Telegramms ergänzt. Dieser umfasst die exakte Wiederholung der Bytes 5 bis 10 vom Kopf eines Command-Telegramms in den ersten sechs Datenbytes sowie einen CRC-Wert, der über die Datenbytes gebildet wird und an diese angehängt wird. Demnach muss die Anzahl der Datenwörter, die im Size-Feld des Telegrammkopfs eines Command-Telegramms angegeben wird, um vier Wörter erhöht werden.

Der CRC-Wert umfasst 16 Bit und wird nach dem Polynom $x^{16} + x^{12} + x^5 + x^0$ (0x1021) gebildet. Dieser CCITT-CRC wird im gesamten Kommunikationsstack angewandt, wo ein CRC zur Absicherung der übertragenen Daten benötigt wird.

Nachfolgend eine einfache Routine in C zur CRC-Berechnung als Beispiel:

```
static const unsigned short crc_table[256] = {
0x0000, 0x1021, 0x2042, 0x3063, 0x4084, 0x50a5, 0x60c6, 0x70e7,
0x8108, 0x9129, 0xa14a, 0xb16b, 0xc18c, 0xd1ad, 0xe1ce, 0xf1ef,
0x1231, 0x0210, 0x3273, 0x2252, 0x52b5, 0x4294, 0x72f7, 0x62d6,
0x9339, 0x8318, 0xb37b, 0xa35a, 0xd3bd, 0xc39c, 0xf3ff, 0xe3de,
0x2462, 0x3443, 0x0420, 0x1401, 0x64e6, 0x74c7, 0x44a4, 0x5485,
0xa56a, 0xb54b, 0x8528, 0x9509, 0xe5ee, 0xf5cf, 0xc5ac, 0xd58d,
0x3653, 0x2672, 0x1611, 0x0630, 0x76d7, 0x66f6, 0x5695, 0x46b4,
0xb75b, 0xa77a, 0x9719, 0x8738, 0xf7df, 0xe7fe, 0xd79d, 0xc7bc,
0x48c4, 0x58e5, 0x6886, 0x78a7, 0x0840, 0x1861, 0x2802, 0x3823,
0xc9cc, 0xd9ed, 0xe98e, 0xf9af, 0x8948, 0x9969, 0xa90a, 0xb92b,
0x5af5, 0x4ad4, 0x7ab7, 0x6a96, 0x1a71, 0x0a50, 0x3a33, 0x2a12,
0xdbfd, 0xcbdc, 0xfbbf, 0xeb9e, 0x9b79, 0x8b58, 0xbb3b, 0xab1a,
0x6ca6, 0x7c87, 0x4ce4, 0x5cc5, 0x2c22, 0x3c03, 0x0c60, 0x1c41,
0xedae, 0xfd8f, 0xcdec, 0xddcd, 0xad2a, 0xbd0b, 0x8d68, 0x9d49,
0x7e97, 0x6eb6, 0x5ed5, 0x4ef4, 0x3e13, 0x2e32, 0x1e51, 0x0e70,
0xff9f, 0xefbe, 0xdfdd, 0xcffc, 0xbf1b, 0xaf3a, 0x9f59, 0x8f78,
0x9188, 0x81a9, 0xb1ca, 0xa1eb, 0xd10c, 0xc12d, 0xf14e, 0xe16f,
0x1080, 0x00a1, 0x30c2, 0x20e3, 0x5004, 0x4025, 0x7046, 0x6067,
0x83b9, 0x9398, 0xa3fb, 0xb3da, 0xc33d, 0xd31c, 0xe37f, 0xf35e,
0x02b1, 0x1290, 0x22f3, 0x32d2, 0x4235, 0x5214, 0x6277, 0x7256,
0xb5ea, 0xa5cb, 0x95a8, 0x8589, 0xf56e, 0xe54f, 0xd52c, 0xc50d,
0x34e2, 0x24c3, 0x14a0, 0x0481, 0x7466, 0x6447, 0x5424, 0x4405,
0xa7db, 0xb7fa, 0x8799, 0x97b8, 0xe75f, 0xf77e, 0xc71d, 0xd73c,
0x26d3, 0x36f2, 0x0691, 0x16b0, 0x6657, 0x7676, 0x4615, 0x5634,
0xd94c, 0xc96d, 0xf90e, 0xe92f, 0x99c8, 0x89e9, 0xb98a, 0xa9ab,
0x5844, 0x4865, 0x7806, 0x6827, 0x18c0, 0x08e1, 0x3882, 0x28a3,
0xcb7d, 0xdb5c, 0xeb3f, 0xfb1e, 0x8bf9, 0x9bd8, 0xabbb, 0xbb9a,
0x4a75, 0x5a54, 0x6a37, 0x7a16, 0x0af1, 0x1ad0, 0x2ab3, 0x3a92,
0xfd2e, 0xed0f, 0xdd6c, 0xcd4d, 0xbdaa, 0xad8b, 0x9de8, 0x8dc9,
0x7c26, 0x6c07, 0x5c64, 0x4c45, 0x3ca2, 0x2c83, 0x1ce0, 0x0cc1,
0xef1f, 0xff3e, 0xcf5d, 0xdf7c, 0xaf9b, 0xbfba, 0x8fd9, 0x9ff8,
0x6e17, 0x7e36, 0x4e55, 0x5e74, 0x2e93, 0x3eb2, 0x0ed1, 0x1ef0
};
WORD CRC16 (BYTE *Data, WORD length)
{
    WORD CRC_16 = 0xFFFF;
    WORD i;
    for (i = 0; i < length; i++)
    {
        CRC_16 = (CRC_16 << 8) ^ (crc_table[(CRC_16 >> 8) ^
(Data[i])]);
    }
    return CRC_16;
}
```

5 Sendemodus *Datenausgabe nur auf Anfrage*

Im Sendemodus *Datenausgabe nur auf Anfrage* werden die Messdaten durch den Hostrechner angefordert (z. B. Block 12: Scan Data). Es werden Send- und Fetch-Telegramme verwendet.

Bei Send-Telegrammen schickt der Hostrechner nach dem Telegrammkopf die zu übertragenden Daten, der Empfänger antwortet mit einem Reply-Telegramm, das nur aus einem Kopf ohne weitere Daten besteht. Bei Fetch-Telegrammen schickt der Hostrechner den Kopf eines Fetch-Telegramms ohne nachfolgende Daten, und der Sensor antwortet mit einem Reply-Telegramm, welches nach dem Telegrammkopf die angeforderten Daten enthält.

Auch im EFI-Verbund ist der Hostrechner immer der aktive Teilnehmer. Die Sensoren senden von sich aus keine RK512-Telegramme. Damit entfällt auch ein möglicher Initialisierungskonflikt bei gleichzeitiger Kommunikationsaufnahme.

5.1 Command-Telegramm

Der Telegrammkopf des Command-Telegramms (Befehlstelegramm) besteht aus 10 Bytes, welche folgende Bedeutungen haben:

Byte	Telegrammfelder	Inhalt	Bedeutung
1	Telegram Identifier	0x00	
2		0x00	
3	Command Telegram Type	‚A' (0x41) oder ‚E' (0x45)	Send-Telegramm oder Fetch-Telegramm
4	Command Data Type	‚D' (0x44)	Zugriff auf Datenblock
5	Destination Address/ Source Address	0 bis 255 (0x00 bis 0xFF)	Blocknummer
6		0 bis 255 (0x00 bis 0xFF)	Blockindex
7	Size	0 bis 65535	Blockgröße in Datenwörtern
8			
9	Coordination Flag	0xFF	
10	Device Address	0x07 oder 0x08	Host Guest

Tabelle: Aufbau Command-Telegramm

5.2 Reply-Telegramm

Der Telegrammkopf des Reply-Telegramms (Reaktionstelegramm) besteht aus 4 Bytes, welche folgende Bedeutung haben:

Byte	Telegrammfelder	Inhalt	Bedeutung
1	Telegram Identifier	0x00 (immer)	
2		0x00 (immer)	
3	Reply Telegram Type	0x00 (immer)	Reply-Telegramm
4	Reply Error Number	0x00 0x01 bis 0xFF	Kein Fehler Fehlercode siehe Fehlertabelle

Tabelle: Aufbau Reply-Telegramm

5.2.1 Fehlercodes des Reply-Telegramms

Das Reply-Telegramm ist die Antwort des S3000/S300 auf ein Send- oder Fetch-Telegramm.

Stellt der S3000/S300 einen Fehler fest, zeigt er dies im Fehlercode des Reply-Telegramms an, und es werden keine Daten nach dem Reply-Telegrammkopf geschickt.

Fehlercode im Reply-Telegramm	Kommunikationsfehler nach dem RK512-Protokoll
0x00	Kein Fehler.
0x01	Der aktuelle Status des Geräts erlaubt keinen Schreibzugriff auf den Datenblock.
0x02	Der Zugriff auf den Datenblock ist der aktuellen Benutzergruppe nicht erlaubt.
0x03	Das Passwort ist nicht korrekt.
0x04	Das System-Token ist belegt.
0x05	Parameter nicht korrekt.
	Der Blockindex der Zieladresse oder Quelladresse im Command-Telegramm (Byte 6) ist unzulässig (nicht im Register Interface definiert).
0x06	Gerät ist aufgrund interner Prozesse ausgelastet. Für Zugriff auf den Datenblock Vorgang wiederholen.
	Interner Fehler des Gerätes.
0x07	Zugriff auf Datenblock im aktuellen Gerätezustand nicht unterstützt.
0x0A	Eine der Überwachungen der Kommunikation ist fehlgeschlagen (u. a. Timeout des EFI-RK512-Pakets/EFI-RK512 Acknowledge oder fehlerhafte Übertragung des EFI-RK512-Pakets/EFI-RK512 Acknowledge).
0x0C	Das Coordination Flag (Byte Number) im Command-Telegramm (Byte 9) ist ungleich 0xFF.
	Die Device Address im Command-Telegramm (Byte 10, Bit 0 bis 3) ist ungültig (d. h. ist gleich 0).
	Die CPU Number im Command-Telegramm (Byte 10, Bit 5 bis 7) ist unzulässig.
0x10	Der Telegram Identifier im Command-Telegramm (Byte 1) ist ungleich 0x00 oder 0xFF oder wird nicht gefolgt von einem weiteren Byte 0x00 (Byte 2).
	Der Command Data Type im Command-Telegramm (Byte 4) ist unzulässig.
0x14	Die Datenblocknummer der Destination Address bzw. Source Address im Command-Telegramm (Byte 5) ist unzulässig (nicht im Register Interface definiert).
0x16	Der Command Telegram Type im Command-Telegramm (Byte 3) ist unzulässig.

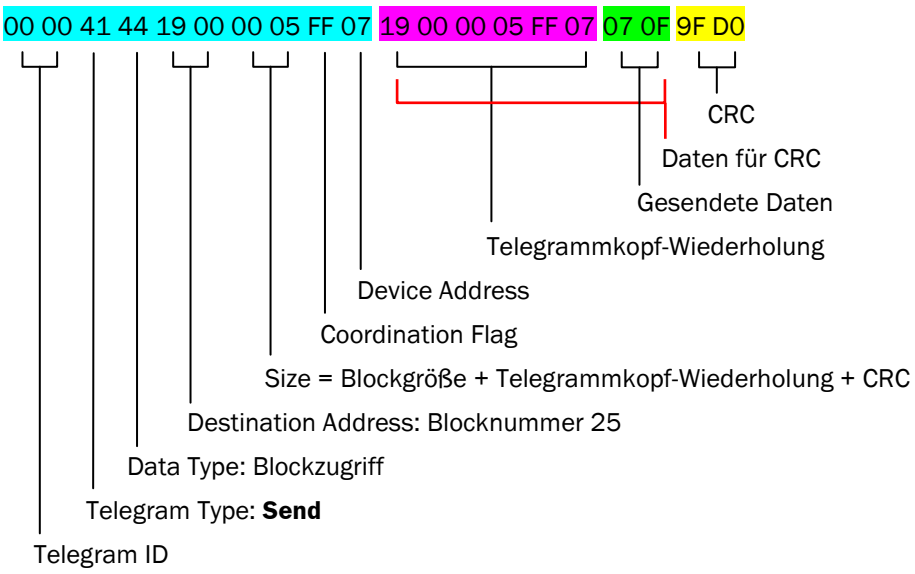
Fehlercode im Reply-Telegramm	Kommunikationsfehler nach dem RK512-Protokoll
0x34	Telegramm-Format-Fehler. Mögliche Ursachen: • Die im Size-Feld des Command-Telegramms angegebene Länge (Byte 7 und 8) übersteigt die im Datenblock ab der angegebenen Adresse verfügbaren Einträge. • Die Länge der Daten des Send-Telegramms war größer als im Size-Feld angegeben. • Die Länge der Daten des Send-Telegrammms war kleiner als im Size-Feld angegeben. • Es wurde ein Fetch-Telegramm mit Nutzdaten empfangen. • Das Send-Telegramm wurde korrekt empfangen, aber der CRC-Wert über die Daten ist falsch oder die ersten sechs Datenbytes stimmen nicht mit den Bytes 5 bis 10 aus dem Telegrammkopf überein.
0x36	Es wurde ein Command-Telegramm empfangen, obwohl noch kein Reply-Telegramm für das vorherige Command-Telegramm versendet wurde.

Tabelle: Fehlercodes Reply-Telegramm

5.3 Standard-Kommunikation

5.3.1 Beispiel für ein Send-Telegramm „Schreiben des Token in Block 25“

Hostrechner Send



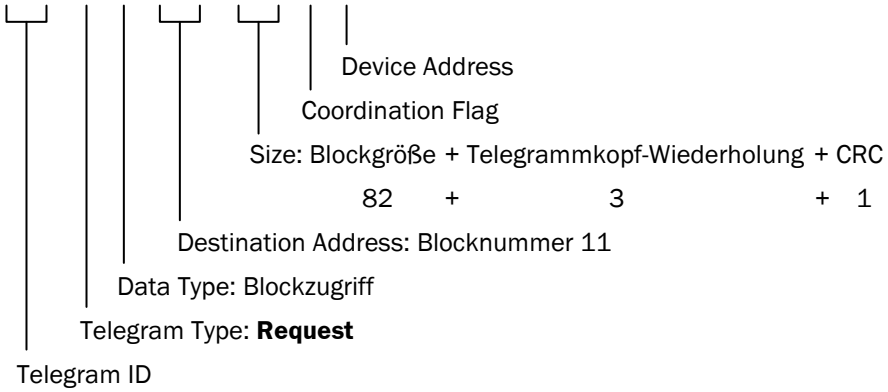
S3000 Reply

00 00 00 00

5.3.2 Beispiel für ein Fetch-Telegramm „Lesen des Operating Data Block 11“

Hostrechner Send

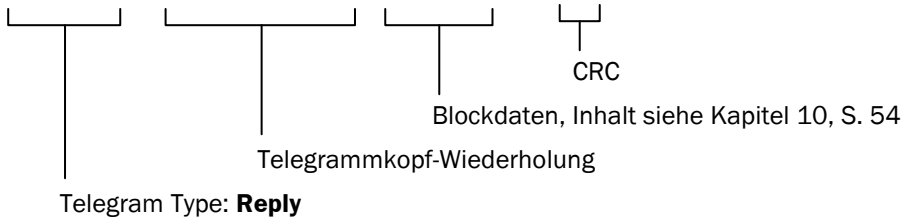
00 00 45 44 0B 00 00 56 FF 07



S3000 Reply

00 00 00 00 0B 00 00 56 FF 07 08 38 FD FD 00 02 00 55 00 00 00 00 00 08 7D 00 C0 02 00 00 35 01 00 00 52 00 61 04 00 00 9F 02 39 02 18 02 6A 00 0C 00 02 00 32 02 1B 00 1A 00 0A 00 49 02 02 00 28 00 14 00 23 02 01 00 04 00 0F 00 00 02 20 00 06 00 04 00 2A 02 1F 00 21 00 05 00 31 02 09 00 17 00 10 00 02 00 19 00 94 00 00 00 00 00 00 00 0A 00 0E 49 87 47 F6 4A 18 44 65 4E A7 00 9C 14 31 02 64 00 5A 00 A5 02 DE 02 07 01 69 01 6D 02 E8 02 A3 13 C3 00 F1 00 07 01 53 01 A6 01 34 02 03 03 3D 04 54 06 05 0A 98 00 C7 08 AC 08 2D 2C

00 00 00 00 0B 00 00 56 FF 07 08 38 FD FD ... 2D 2C



5.4 Anforderung von Daten im Sendemodus *Datenausgabe nur auf Anfrage*

Beim S3000 und beim S300 können Messdatenblöcke mit statischer Länge (Block 12), für den S3000 optional auch Messdatenblöcke mit flexibler Länge (Block 112) angefordert werden.

Beim S3000 mit Firmware des Sensorkopfes ≥ B02.40 kann je nach eingestellter Auflösung Block 58 (bei 0,5° Scanauflösung) oder Block 59 (bei 0,25° Scanauflösung) angefordert werden. Diese Blöcke haben eine statische Länge.

Beim S300 mit Firmware ≥ 2.10 kann Block 58 mit statischer Länge angefordert werden.

Beispiel 1: Es existiert nur ein S3000 und es sollen Messdaten empfangen werden.

1. Power On
2. Get Token (Send-Telegramm mit Device Address 0x07)
3. Read Scandatensatz 1 (Fetch-Telegramm mit Device Address 0x07)
4. Read Scandatensatz 2 (Fetch-Telegramm mit Device Address 0x07)

5. Read Scandatensatz n (Fetch-Telegramm mit Device Address 0x07)
6. Release Token (Send-Telegramm mit Device Address 0x07)

Beispiel 2: Es existiert ein EFI-Verbund aus zwei S3000 und es sollen abwechselnd Messdaten von beiden Scannern empfangen werden. Es werden 2 getrennte RS-422-Verbindungen vorausgesetzt.

1. Power On
2. Get Token S3000 (Host) (Send-Telegramm mit Device Address 0x07)
3. Read Scandatensatz von S3000 (Host) (Fetch-Telegramm mit Device Address 0x07)
4. Release Token S3000 (Host) (Send-Telegramm mit Device Address 0x07)
5. Get Token S3000 (Guest) (Send-Telegramm mit Device Address 0x08)
6. Read Scandatensatz von S3000 (Guest) (Fetch-Telegramm mit Device Address 0x08)
7. Release Token S3000 (Guest) (Send-Telegramm mit Device Address 0x08)

5.4.1 Beispiel für Kommunikation im Sendemodus *Datenausgabe nur auf Anfrage*

Get Token

Hostrechner Send: 00 00 41 44 19 00 00 05 FF 07 19 00 00 05 FF 07 07 0F 9F D0

S3000 Reply: 00 00 00 00

Read Scan Data (Block 12)

Hostrechner Send: 00 00 45 44 0C 00 02 FE FF 07

S3000 Reply: 00 00 00 00 0C 00 02 FE FF 07 00 08 3B 00 3D 00 ... 00 00 FE E9

Read Extended Scan Data (Block 112)

Hostrechner Send: 00 00 45 44 70 00 03 02 FF 07

S3000 Reply: 00 00 00 00 70 00 03 02 FF 07 01 00 00 00 14 4B ... 29 00 26 8B

Read Scan Data 05 Block (Block 58)

Hostrechner Send: 00 00 45 44 3A 00 01 8F FF 07

S3000 Reply: 00 00 00 00 70 00 03 02 FF 07 01 00 00 00 07 00 ... 00 00 E1 C3

Read Scan Data 025 Block (Block 59)

Hostrechner Send: 00 00 45 44 3B 00 03 0B FF 07

S3000 Reply: 00 00 00 00 3B 00 03 0B FF 07 01 00 00 00 07 00 ... 00 00 C5 12

Release Token

Hostrechner Send: 00 00 41 44 19 00 00 05 FF 07 19 00 00 05 FF 07 00 00 E7 B8

S3000 Reply: 00 00 00 00

5.5 Flexible Telegramme (nur S3000)

Bei einigen Hostrechnern besteht die Forderung, die Interrupt-Belastung für den UART so gering wie möglich zu halten. In solchen Fällen kann (im Sendemodus *Datenausgabe nur auf Anfrage*) ein Datenblock mit flexibler Länge im Reply-Telegramm verwendet werden (Block 112 statt Block 12).

Hinweis Der Block 112 ist nur von einem direkt angeschlossenen (lokalen) Scanner verfügbar. Die Ausgabe des Blocks eines zweiten Scanners, der über EFI am lokalen Scanner angeschlossen ist, ist nicht möglich.

6 Sendemodus *Kontinuierliche Datenausgabe*

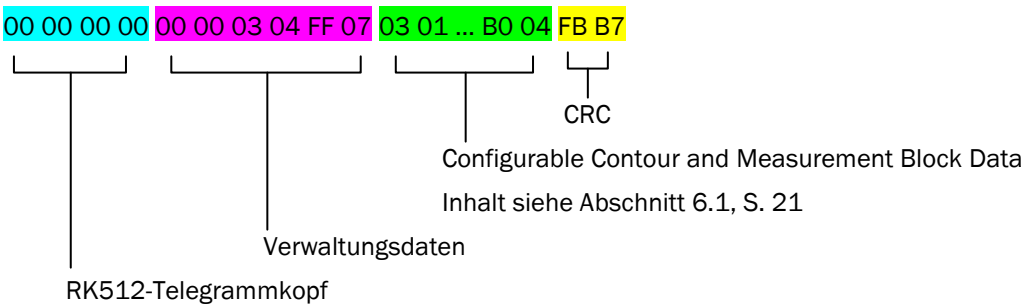
Um einen möglichst effizienten Telegrammverkehr aufbauen zu können, kann der S3000 bzw. S300 in der CDS so konfiguriert werden, dass er die Messwerte und einige Zusatzinformationen permanent an der RS-422-Schnittstelle aussendet. Die kontinuierliche Datenausgabe wird nicht durch den Telegrammverkehr über die anderen zur Verfügung stehenden Schnittstellen beeinträchtigt. Für die kontinuierliche Datenausgabe ist es nicht erforderlich, dass das Token für die RS-422-Schnittstelle reserviert wird (im Sendemodus *Datenausgabe nur auf Anfrage* kann immer nur eine Schnittstelle das Token besitzen, siehe Abschnitt 4.2 „System-Token“ auf S. 11).

Bei der kontinuierlichen Datenausgabe erfolgt die Ausgabe der Messdaten automatisch, die Telegramme müssen nur gelesen werden.

Im Sendemodus *Kontinuierliche Datenausgabe* kann nicht direkt ein Request-Telegramm vom Hostrechner gesendet werden. Der Hostrechner muss zuerst die kontinuierliche Datenausgabe unterbrechen (siehe Abschnitt 6.5 „Anhalten der Datenausgabe“ auf Seite 25).

Beispiel: Telegrammaufbau kontinuierliche Datenausgabe

00 00 00 00 00 00 03 04 FF 07 03 01 00 00 17 01 00 00 00 00 BB BB 11 11 E8 03 E8 03 E8 03 ... B0 04 FB B7



Hinweis Im Sendemodus *Kontinuierliche Datenausgabe* können an der RS-422-Schnittstelle nur Daten des direkt angeschlossenen (lokalen) Scanners ausgegeben werden. Die Ausgabe von Daten eines zweiten Scanners, der über EFI am lokalen Scanner angeschlossen ist, ist nicht möglich.

6.1 Aufbau der kontinuierlichen Datenausgabe

6.1.1 Telegrammkopf, Verwaltungsdaten, allgemeine Daten

Die Datenausgabe beginnt immer wie folgt:

00 00 00 00 4 Byte RK512-Telegrammkopf: Reply-Telegramm

00 00 Datenblocknummer 0x0000 für kontinuierliche Datenausgabe

xx xx Größe des Telegramms in 16-bit-Datenwörtern

S3000

Die Telegrammlänge wird aus den Daten hinter dem Telegrammkopf (vom ersten Byte der Verwaltungsdaten, 5. Byte des Telegramms) bis zum letzen Byte des Telegramms (inkl. CRC) berechnet. Das Längenfeld enthält also den Wert:
(Gesamtlänge in Bytes – 4)/2

S300: Wenn keine IO-Daten und keine Sektoren konfiguriert sind

Die Telegrammlänge wird aus den Daten hinter dem Längenfeld (vom 5. Byte der Verwaltungsdaten, 9. Byte des Telegramms) bis zum letzen Byte des Telegramms (inkl. CRC) berechnet. Das Längenfeld enthält also den Wert:
(Gesamtlänge in Bytes – 8)/2

S300; Wenn IO-Daten oder mindestens ein Sektor konfiguriert sind

Die Telegrammlänge wird aus den Daten hinter der Protokoll-Version in den Nutzdaten (vom 3. Byte der Nutzdaten, 13. Byte des Telegramms) bis zum letzen Byte des Nutzdatenblocks (letztes Byte vor dem CRC-Wert) berechnet. Das Längenfeld enthält also den Wert:
(Gesamtlänge in Bytes – 14)/2

S300: Im Kompatibilitätsmodus

Die Telegrammlänge wird aus den Daten hinter dem Telegrammkopf (vom ersten Byte der Verwaltungsdaten, 5. Byte des Telegramms) bis zum letzen Byte des Telegramms (inkl. CRC) berechnet. Das Längenfeld enthält also den Wert:
(Gesamtlänge in Bytes – 4)/2

FF 07 Coordination Flag und Device Address, hier 0x07 (Host oder Standalone-Gerät)

03 01 Protokoll-Versionsnummer: 0x0103

Im Kompatibiltätsmodus abweichend: 02 01 Protokoll-Versionsnummer: 0x0102

Detaillierte Informationen siehe Abschnitt 6.2 „Protokoll-Versionsnummer“ auf S. 22.

00 00 oder 01 00 Status Normal 0x0000 oder Lockout 0x0001

17 01 00 00 Scannummer (Zeitstempel), hier 0x00000117 (siehe Abschnitt 7.1, S. 26)

02 00 Telegrammnummer, hier 0x0000

6.1.2 Messdaten (Distanz)

BB BB **ID für Messdaten**

11 11 ID für Messdaten aus Messbereich 1

xx xx Messwerte aus Messbereich 1

...

Detaillierte Informationen zu den Datenformaten siehe Abschnitt 6.3 „Messdatenformate“ auf S. 23.

6.1.3 CRC

Abschließend wird der CRC-Wert ausgegeben:

xx xx 16 Bit CRC

Der CRC-Wert wird über die Daten hinter dem Telegrammkopf (vom ersten Byte der Verwaltungsdaten, 5. Byte des Telegramms) bis zum letzen Byte des Nutzdatenblocks gebildet (letztes Byte vor dem CRC-Wert).

6.2 Protokoll-Versionsnummer

S3000/S300: 0x0103

Im Kompatibilitätsmodus: S3000/S300: 0x0102

Die Protokoll-Versionsnummer sollte vom Hostrechner geprüft werden. Sie ist abhängig von der Firmwareversion im verwendeten Sensor und davon, ob der Kompatibilitätsmodus aktiviert ist.

Bei einer anderen Versionsnummer kann der Aufbau der kontinuierlichen Datenausgabe abweichen.

6.3 Messdatenformate

Eine Erläuterung der in den folgenden Tabellen verwendeten Benennung der Felder finden Sie in Abschnitt 7.2 „Benennung der Schutz- und Warnfelder“ auf Seite 26.

6.3.1 Datenformat der Messdaten für S3000 (2 Byte)

Bit 15 ... 13	Bit 12 ... 0
Status-Bits Bit 15: Eingriff innerhalb Feld C oder D erkannt (wenn das Feld als Schutzfeld aktiviert ist) Bit 14: Eingriff innerhalb Feld A oder B erkannt (wenn das Feld als Schutzfeld aktiviert ist) Bit 13: CMS-Modelle: Reflektor erkannt Nicht-CMS-Modelle: Scanner geblendet **Abweichend davon gilt im Kompatibilitätsmodus:** Bit 15: Messwert innerhalb simultanem Schutzfeld erkannt Bit 14: Messwert innerhalb Schutzfeld erkannt	Gemessene Entfernung in Zentimetern

6.3.2 Datenformat der Messdaten für S300 (2 Byte)

Bit 15 ... 13	Bit 12 ... 0
Status-Bits Bit 15: Firmware < 2.10: Messwert innerhalb Warnfeld erkannt Firmware ≥ 2.10: 0 (fixer Wert des Bits) Bit 14: Messwert innerhalb Schutzfeld erkannt Bit 13: CMS-Modelle: Reflektor erkannt Nicht-CMS-Modelle: Scanner geblendet	Gemessene Entfernung in Zentimetern

6.4 Beispiel für kontinuierliche Datenausgabe mit S3000

Konfiguration: Ausgabe aller Messwerte

Ausgabe aller Messwerte aus einem kompletten Scan, kontinuierliche Datenausgabe, 0,25° Winkelauflösung (120 ms Basisansprechzeit)

Empfang eines Messdatensatzes

...

00 00 00 00 00 00 03 04 FF 07 03 01 00 00 17 01 00 00 00 00 BB BB 11 11 E8 03 E8 03 E8 03 ... B0 04 FB B7

...

Erläuterung des Messdatensatzes

00 00 00 00 4 Byte RK512-Telegrammkopf: Reply-Telegramm

00 00 Datenblocknummer 0x0000 für kontinuierliche Datenausgabe
03 04 Größe des Telegramms in 16-bit-Datenwörtern: 772 Datenwörter
FF 07 Coordination Flag und Device Address, hier 0x07 (Host oder Standalone-Gerät)

03 01 Protokoll-Versionsnummer: 01.03

00 00 Status: normal

17 01 00 00 Scannummer (Zeitstempel): hier 0x00000117 = 279

00 00 Telegrammnummer: 0

BB BB ID für Messdaten

11 11 ID für Messdaten aus Messbereich 1 (gesamter Messbereich, beim S3000: 190°, beim S300: 270°)

E8 03 Messwert 1 im aktuellen Messbereich (bei 0°, entspricht –5° im Koordinatensystem des S3000): 0x03E8,
in Bit-Schreibweise: 0000 0011 1110 1000
Bit 15: 0: kein Eingriff in Feld C und D (sofern als Schutzfeld aktiviert)
Bit 14: 0: kein Eingriff in Feld A und B (sofern als Schutzfeld aktiviert)
Bit 13: 0: Scanner nicht geblendet
Bits 12 ... 0: Distanz in cm: 0x03E8 = 1000 [cm]
(512 cm + 256 cm + 128 cm + 64 cm + 32 cm + 8 cm = 1000 cm)

E8 03 Messwert 2 im aktuellen Messbereich (bei 0,25°, entspricht –4,75° im Koordinatensystem des S3000): 0x03E8,
in Bit-Schreibweise: 0000 0011 1110 1000
Bit 15: 0: kein Eingriff in Feld C und D (sofern als Schutzfeld aktiviert)
Bit 14: 0: kein Eingriff in Feld A und B (sofern als Schutzfeld aktiviert)
Bit 13: 0: Scanner nicht geblendet
Bits 12 ... 0: Distanz in cm: 0x03E8 = 1000 [cm]

E8 03 Messwert 3 im aktuellen Messbereich (bei 0,5°, entspricht –4,5° im Koordinatensystem des S3000): 0x03E8,
in Bit-Schreibweise: 0000 0011 1110 1000
Bit 15: 0: kein Eingriff in Feld C und D (sofern als Schutzfeld aktiviert)
Bit 14: 0: kein Eingriff in Feld A und B (sofern als Schutzfeld aktiviert)
Bit 13: 0: Scanner nicht geblendet
Bits 12 ... 0: Distanz in cm: 0x03E8 = 1000 [cm]

...

B0 04 Letzter Messwert im aktuellen Messbereich (Messwert 761 bei 190°, entspricht 185,0° im Koordinatensystem des S3000): 0x04B0,
in Bit-Schreibweise: 0000 0100 1011 0000
Bit 15: 0: kein Eingriff in Feld C und D (sofern als Schutzfeld aktiviert)
Bit 14: 0: kein Eingriff in Feld A und B (sofern als Schutzfeld aktiviert)
Bit 13: 1: Scanner nicht geblendet
Bits 12 ... 0: Distanz in cm: 0x04B0 = 1200 [cm]

FB B7 16 Bit CRC

6.5 Anhalten der Datenausgabe

Im Sendemodus *Kontinuierliche Datenausgabe* kann nicht direkt ein Request-Telegramm vom Hostrechner gesendet werden.

Der Hostrechner muss zuerst die kontinuierliche Datenausgabe unterbrechen. Dies erfolgt durch das Senden eines Zeichens 0x41. Jetzt kann der Hostrechner wie im Sendemodus *Datenausgabe nur auf Anfrage* kommunizieren, solange die konfigurierbare Silentzeit noch nicht verstrichen ist. Danach setzt die Ausgabe der Messdaten automatisch wieder ein.

Hinweis Die kontinuierliche Datenausgabe erfolgt nur in den Systemzuständen *Normal* und *Lockout*. In allen anderen Systemzuständen wird die kontinuierliche Datenausgabe automatisch deaktiviert.

6.6 Fest konfigurierte Modi der kontinuierlichen Datenausgabe

Mit der CDS wird die Messdatenausgabe zunächst fest konfiguriert.

Diese Konfiguration bleibt permanent im Gerät erhalten, solange keine neue Konfiguration an das Gerät übertragen wird.

Bei jedem Einschalten wird diese Konfiguration aus dem Speicher des Systemsteckers geladen.

7 Weitere Informationen zu den Messdaten

7.1 Zusätzliche Zeitstempel und Telegrammnummern

In einem bewegten Transportfahrzeug ist die Zuordnung eines Messwertsatzes oder des Reflektordatensatzes mit einer Zeitmarke für den Hostrechner notwendig, damit der Messwertsatz mit der richtigen Position und der richtigen Orientierung des Fahrzeugs ausgewertet wird. Deshalb ist im Sensor ein globaler Zähler (32 Bit) realisiert, der beim Block 112 in den Sendemodi *Datenausgabe nur auf Anfrage* (nur S3000) und *Kontinuierliche Datenausgabe* mit ausgegeben wird. Dieser Zähler wird bei jedem Scan, also alle 40 ms (beim S300) bzw. je nach Modus alle 30 ms oder 60 ms (beim S3000) intern inkrementiert.

Zusätzlich besitzen diese Blöcke je eine eigene Telegrammnummer, die nur bei Ausgabe des Blocks inkrementiert wird.

7.2 Benennung der Schutz- und Warnfelder

In den Erläuterungen zu den Telegrammen werden die Schutz- und Warnfelder mit den Buchstaben A bis D bezeichnet. Die Zuordnung dieser Buchstaben zu den Schutz- und Warnfeldern wird in der folgenden Tabelle erläutert:

Feld	S3000 Dual-Feldmodus	S3000 Triple-Feldmodus	S3000 Vier simultane Schutzfelder	S300
A	Schutzfeld	Schutzfeld	Schutzfeld 1	Schutzfeld
B	Warnfeld	Warnfeld 1	Schutzfeld 2	Warnfeld 1
C	Simultanes Schutzfeld	–	Simultanes Schutzfeld 1	–
D	Simultanes Warnfeld	Warnfeld 2	Simultanes Schutzfeld 2	Warnfeld 2

Im Kompatibilitätsmodus:

Feld	S3000	S300
A	Schutzfeld	Schutzfeld
B	Warnfeld	Warnfeld
C	Simultanes Schutzfeld	–
D	Simultanes Warnfeld	–

8 Fehlerdiagnose

Für die Diagnose der Einstellungen an Ihrem Sensor stehen Ihnen folgende Möglichkeiten zur Verfügung:

Sie können die Blöcke, die Sie online ändern, jederzeit wieder aus dem Sensor zurücklesen, um sicherzustellen, dass die Einstellungen im Gerät korrekt sind.

Mit Hilfe der CDS stehen Ihnen folgende Diagnose-Möglichkeiten zur Verfügung:

- Anzeige der im Gerät abgespeicherten Konfiguration.
- Darstellung der aktuellen Einstellung des Sensors im Betriebszustandsbericht.

9 Glossar

CDS	SICK Configuration & Diagnostic Software
Device Address	Geräteadresse für Kommunikation
Diamond Grade	Reflektorfolie mit entsprechenden optischen Eigenschaften
EFI	siehe Enhanced Function Interface
Enhanced Function Interface	sichere SICK-Gerätekommunikation
Kontinuierliche Datenausgabe	permanenter Sende-Modus der Messdaten
Messbereich	Segment im Scanfeld
Messdaten	vom Sensor gemessene Entfernungswerte
Protokoll-Versionsnummer	Firmware-/Gerätekennung für den Hostrechner
Remote-Betrieb	zwei S3000/S300 im EFI-Verbund
RK512 Telegram Header	Protokoll-Definition für Datenkommunikation
Roh-Geschwindigkeitsdaten	aktuell gemessene Inkrementalgeberwerte
Scandatensatz	Entfernungswerte eines Messumlaufs (0...190°/0...270°)
Silentzeit	Pausezeit bei kontinuierlicher Datenausgabe
Volltreffer	komplette Fläche des Laserstrahls trifft auf ein Objekt
Zeitstempel	Zeitmarke, die bei der Datengenerierung ermittelt wird

Contents

1 About this document

Please read this chapter carefully before you begin working with this documentation and the measured data output of the S3000 or S300.

1.1 Purpose of this document

This telegram listing describes the measuring-data-specific functional extension of the S3000 Standard/Advanced/Professional/Remote and the S300 Standard/Advanced/Professional (details on the scope see section 1.4 "Scope" on page 32).
This document is to be considered a supplement to the S3000 and S300 operating instructions.

WARNING

Please refer to the operating instructions for the S3000 and S300 for general information, such as mounting, installation and commissioning of the safety laser scanner. Please observe the safety notes detailed in chapters 2 and 8 of the above mentioned document before commissioning the system.

The telegram data made available by the laser scanner may not be used for safety applications.

1.2 Target group

This telegram listing is written for system specialists working in the field of hardware and software development intending to integrate and evaluate the scanner's internal measured data into host applications.

1.3 Information depth

This telegram listing contains information about the following topics:

- Description of the RS-422 interface
- Description of the RK512 protocol used
- Description of the scanner-related special functions
- Notes on use
- Fault diagnosis

1.4 Scope

This telegram listing is applicable to laser scanner S3000 Standard/Advanced/Professional/Remote and laser scanner S300 Standard/Advanced/Professional with the following type codes:

S3000: S30**A**-XXXX X**A**

S300: S30**B**-XXXX X**A**

Note The laser scanners S300 Standard and S300 Advanced support measured data output only if they are equipped with a system plug with a serial number ≥ 12210000. Therefore, this telegram listing is not applicable for devices with an older system plug.

2 System description

2.1 Data output

Safety laser scanner S3000 Standard/Advanced/Professional/Remote and S300 Standard/Advanced/Professional can output measured data via the RS-422 interface.

This data can be used for general monitoring and control tasks. They are particularly applicable for purposes of navigation support for automated guided vehicles (AGVs).

WARNING

The telegram data made available by the laser scanner may not be used for safety applications.

Note If you use the extended CMS functions you should always use a CMS device as a replacement for a CMS device whenever a device needs to be replaced.

Configuration of the measured data output is realized in combination with scanner configuration via one of the communications interfaces (RS-232, RS-422, EFI).

During operation the data is received and processed by a host computer via the RS-422 interface. The data transfer is undertaken in the form of telegrams in accordance with the RK512 protocol.

The data output is realized in various ways depending on the configuration:

- The data telegrams are requested individually by the host computer (send mode *Data output on request*).
- The data telegrams are output continuously by the safety laser scanner (send mode *Continuous data output*).

2.1.1 Compatibility mode

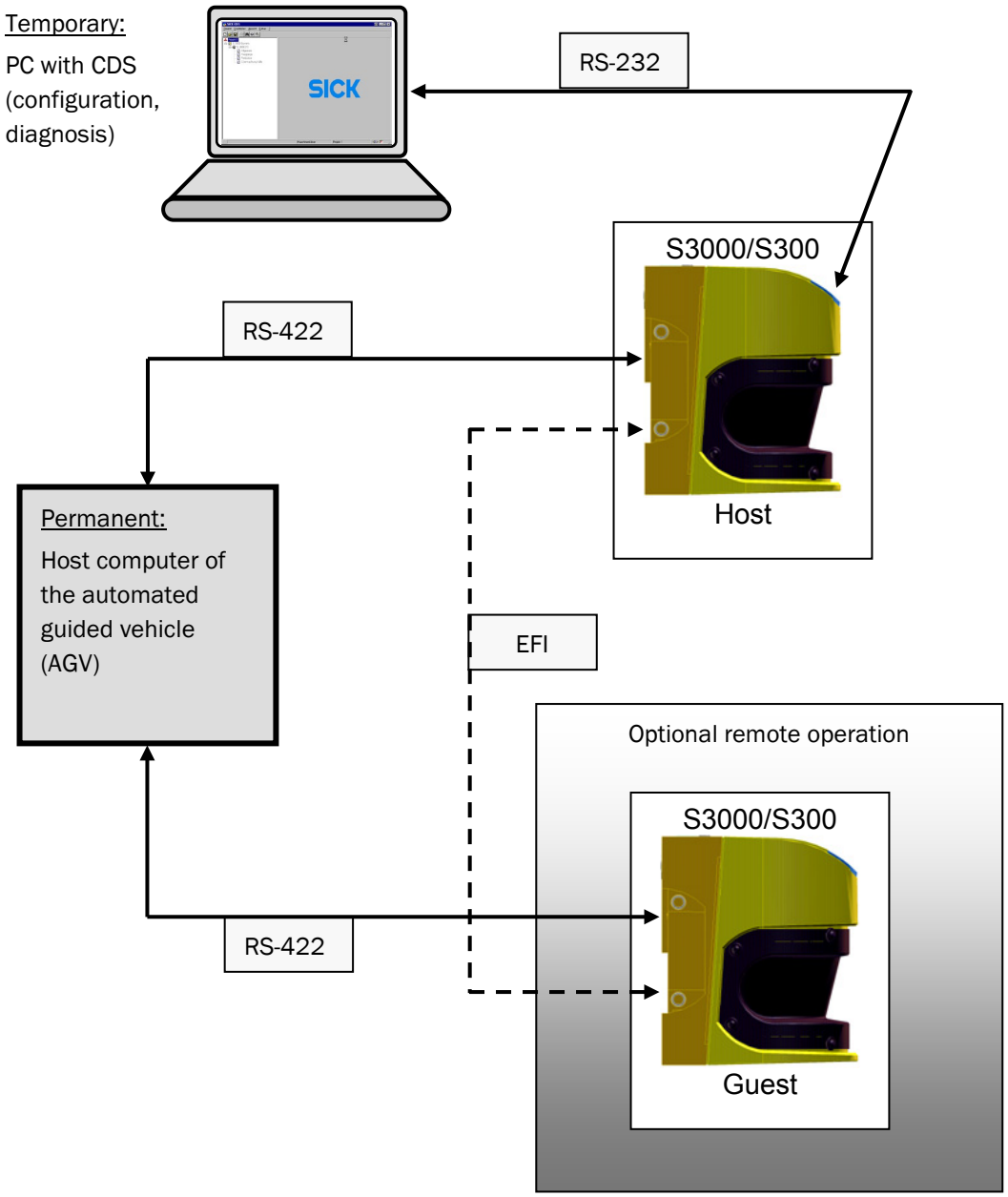
In order to ensure compatibility with older models, safety laser scanner S3000 with firmware ≥ B02.40 and safety laser scanner S300 with firmware ≥ 02.10 can be operated in compatibility mode. You can activate compatibility mode via the device selection wizard on the CDS (SICK Configuration & Diagnostic Software).

The measured data output for the S3000 Standard/Advanced/Professional/Remote in compatibility mode is identical to that of the S3000 with firmware < B02.40; measured data output for the S300 Standard/Advanced/Professional in compatibility mode is identical to that of the S300 with firmware < 02.10.

Further information regarding compatibility mode can be found in the operating instructions for the S3000/S300 (item no. 8009942/8010948).

This document highlights any deviating settings or outputs which apply to compatibility mode.

2.2 System construction



2.3 Electrical interface

The electrical interface is implemented in accordance with the EIA RS-422-A standard.

The options for electrical connection are detailed in the operating instructions for the S3000/S300 in the "Electrical Installation" chapter.

Connection via the RS-422 interface may be maintained in operation. However, the RS-232 interface (configuration interface) is designed solely for temporary connection during the configuration process.

2.3.1 Transfer and data formats

A data byte is composed of 1 start bit, 8 data bits, 1 stop bit and no parity bit.

The baud rate on the RS-422 interface can be configured to the following baud rates with the help of CDS:

- 9600 Baud
- 19200 Baud
- 38400 Baud
- 115.2 kBaud (S300 only)
- 125 kBaud
- 230.4 kBaud (S300 only)
- 250 kBaud
- 460.8 kBaud (S300 only)
- 500 kBaud

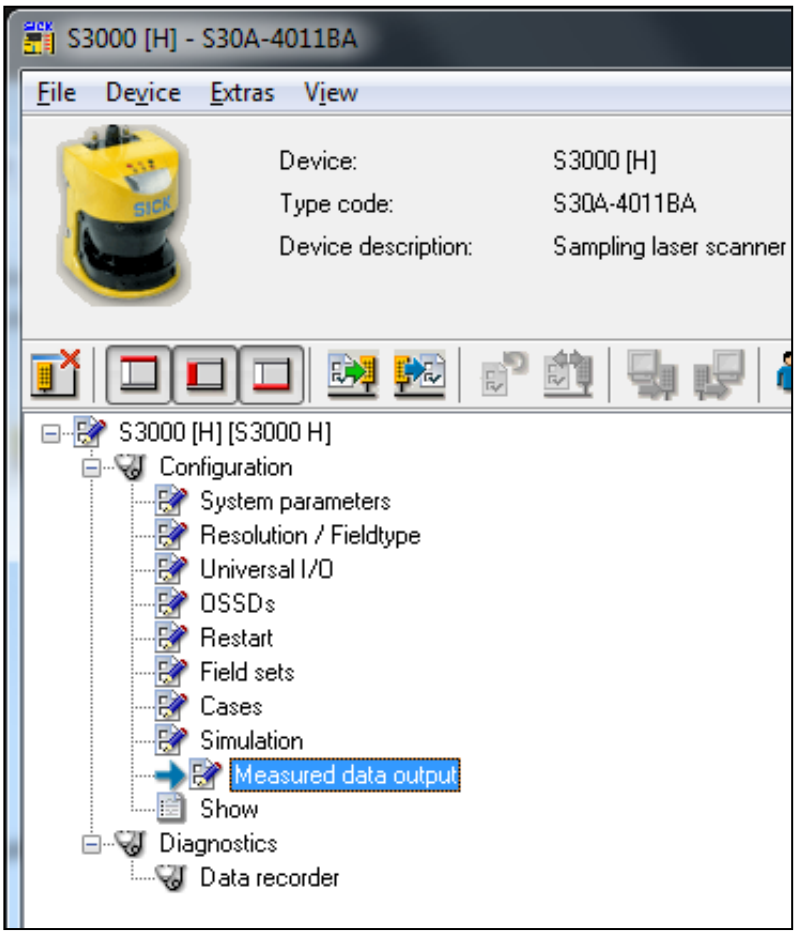
The interface is preconfigured ex factory to a default baud rate of 38400 baud.

S3000 is able to transfer all measured data in (near) real-time (with a delay of approx one mirror rotation, i.e. 30 ms or 60 ms, depending on mode), if the interface is set to 500 kBaud. Lower baud rates or higher network loads will mean that the system cannot evaluate every scan, so that data from individual or multiple measurements will be dropped and only data from every second or third, etc. measurement will be output.

S300 can transfer the measured data of every second scan in real-time, if the interface is set to 500 kBaud. Lower baud rates or higher network loads will mean that the system evaluates less scans, so that data from individual or multiple measurements will be dropped and only data from every third or fourth, etc. measurement will be output.

3 Configuration for measured data output

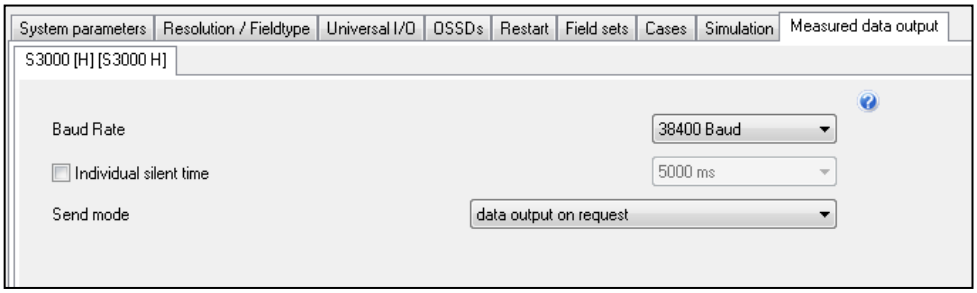
3.1 CDS user interface



Note The figures for the user interface in this chapter are intended as examples only. The actual appearance of the user interface can vary depending on the software version, device and field mode.

Configuration of measured data output is realized in the CDS using the device symbol *S3000* or *S300* in the *Measured data output* area.

3.2 Basic settings



3.2.1 Baud rate

The baud rate of the RS-422 interface can be configured via the corresponding menu item (see section 2.3.1 "Transfer and data formats" on page 35 for further information).

3.2.2 Individual silent time

The silent time feature serves to free up the interface in send mode *Continuous data output*. In order to do so, the host computer is able to interrupt data output for the duration of the configured silent time (see section 6.5 "Stopping data output" on page 50 for further information). Access to the interface is subsequently possible. Data output is automatically resumed once the silent time has elapsed.

A silent time of 5000 ms is preconfigured ex factory.

3.2.3 Send mode

Data output on request:	Data is only output when requested (see chapter 5 "Send mode *Data output on request*" on page 41).
Continuous data output:	Data is output permanently (see chapter 6 "Send mode *Continuous data output*" on page 46).

4 Communication types

4.1 Device addresses

For communication of the devices in remote operation, the communications addresses (device address) for host and guest are required.

The device address is 0x07 for individual scanners.

If two scanners are used in a system, then the addresses are assigned as follows:

- Host: 0x07
- Guest: 0x08

The address is specified in the RK512 telegram header (see section 5.1 "Command telegram" on page 41).

4.2 System token

The token serves to manage the various communications portals (RS-232, RS-422, EFI). A device does not permit simultaneous access to various interfaces. This applies to all interfaces for the participating devices in an EFI system. Access can only be realized via one of the individual interfaces. This is ensured by requesting and successfully assigning the token prior to reading or writing data.

If the measured data interface (RS-422) is in continuous data output mode, then communication can be simultaneously transferred via the configuration interface (RS-232) or EFI. The continuous data output is not affected by this.

Exception:

In send mode *Continuous data output* it is not possible to directly send a request telegram from the host computer. The host computer must first interrupt continuous data output (see section 6.5 "Stopping data output" on page 50).

A serial interface must always address the connected device to obtain the token. It is not possible to access device data without prior assignment of the token. The token is not stored when the system is shut down and must be re-requested when re-started.

You can request the token by sending a send telegram, e.g. for access to an individual scanner (without EFI system) writing the value 0x0F07 to Block 25, via the RS-232 interface.

You can release the token by sending a send telegram to write value 0x0000 to block 25.

An example for communication including writing and releasing the token is given in section 5.4.1 "Example for communication in send mode *Data output on request*" on page 45.

Detailed information relating to data formats can be found in the appendix in section 10.1.3 "Config master block (block no. 25)" on page 61 for the S3000 and in section 10.2.3 "Config master block (block no. 25)" on page 79 for the S300.

4.3 Telegram structure

Communication according to the RK512 standard is based on command and reply telegrams. A command telegram is either a send or fetch telegram. The Send mode *Data output on request* is based on this communications structure: The host computer sends a fetch telegram to the scanner in order to query measured data. The scanner sends the requested data in a reply telegram. Detailed information about the structure of command and reply telegrams can be found in chapter 5 "Send mode *Data output on request*" on page 41.

The data from scanners is also transferred via telegrams in send mode *Continuous data output*. A request is sent by the host computer (detailed information in chapter 6 "Send mode *Continuous data output*" on page 46). If necessary, continuous data output can be interrupted in order to send command telegrams to the scanner (see section 6.5 "Stopping data output" on page 50).

The high byte (HB) is transferred first for values comprised of 2 bytes in the telegram header. The low byte (LB) is transferred first for data bytes of 16 and 32 bit words.

The value of the size field always designates the number of 16 bit data words. It is not possible to access individual bytes.

4.4 Data integrity

As the RK512 standard does not contain a mechanism for checking the integrity of the received data, a mechanism for this purpose is provided by the data in the RK512 telegram. This comprises precise repeating of bytes 5 to 10 in the header of the command telegram in the first six data bytes as well as a CRC value which is formed from the data bytes and which is appended to the telegram. Therefore, the number of data words specified in the size field of the command telegram header must be increased by four words.

The CRC value is comprised of 16 bits and is formed according to the following polynomial $x^{16} + x^{12} + x^5 + x^0$ (0x1021). This CCITT-CRC is applied in the communication stack wherever a CRC is required to protect the transferred data.

The following is a straightforward sample routine in C for CRC calculation:

```
static const unsigned short crc_table[256] = {
0x0000, 0x1021, 0x2042, 0x3063, 0x4084, 0x50a5, 0x60c6, 0x70e7,
0x8108, 0x9129, 0xa14a, 0xb16b, 0xc18c, 0xd1ad, 0xe1ce, 0xf1ef,
0x1231, 0x0210, 0x3273, 0x2252, 0x52b5, 0x4294, 0x72f7, 0x62d6,
0x9339, 0x8318, 0xb37b, 0xa35a, 0xd3bd, 0xc39c, 0xf3ff, 0xe3de,
0x2462, 0x3443, 0x0420, 0x1401, 0x64e6, 0x74c7, 0x44a4, 0x5485,
0xa56a, 0xb54b, 0x8528, 0x9509, 0xe5ee, 0xf5cf, 0xc5ac, 0xd58d,
0x3653, 0x2672, 0x1611, 0x0630, 0x76d7, 0x66f6, 0x5695, 0x46b4,
0xb75b, 0xa77a, 0x9719, 0x8738, 0xf7df, 0xe7fe, 0xd79d, 0xc7bc,
0x48c4, 0x58e5, 0x6886, 0x78a7, 0x0840, 0x1861, 0x2802, 0x3823,
0xc9cc, 0xd9ed, 0xe98e, 0xf9af, 0x8948, 0x9969, 0xa90a, 0xb92b,
0x5af5, 0x4ad4, 0x7ab7, 0x6a96, 0x1a71, 0x0a50, 0x3a33, 0x2a12,
0xdbfd, 0xcbdc, 0xfbbf, 0xeb9e, 0x9b79, 0x8b58, 0xbb3b, 0xab1a,
0x6ca6, 0x7c87, 0x4ce4, 0x5cc5, 0x2c22, 0x3c03, 0x0c60, 0x1c41,
0xedae, 0xfd8f, 0xcdec, 0xddcd, 0xad2a, 0xbd0b, 0x8d68, 0x9d49,
0x7e97, 0x6eb6, 0x5ed5, 0x4ef4, 0x3e13, 0x2e32, 0x1e51, 0x0e70,
0xff9f, 0xefbe, 0xdfdd, 0xcffc, 0xbf1b, 0xaf3a, 0x9f59, 0x8f78,
0x9188, 0x81a9, 0xb1ca, 0xa1eb, 0xd10c, 0xc12d, 0xf14e, 0xe16f,
0x1080, 0x00a1, 0x30c2, 0x20e3, 0x5004, 0x4025, 0x7046, 0x6067,
0x83b9, 0x9398, 0xa3fb, 0xb3da, 0xc33d, 0xd31c, 0xe37f, 0xf35e,
0x02b1, 0x1290, 0x22f3, 0x32d2, 0x4235, 0x5214, 0x6277, 0x7256,
0xb5ea, 0xa5cb, 0x95a8, 0x8589, 0xf56e, 0xe54f, 0xd52c, 0xc50d,
0x34e2, 0x24c3, 0x14a0, 0x0481, 0x7466, 0x6447, 0x5424, 0x4405,
0xa7db, 0xb7fa, 0x8799, 0x97b8, 0xe75f, 0xf77e, 0xc71d, 0xd73c,
0x26d3, 0x36f2, 0x0691, 0x16b0, 0x6657, 0x7676, 0x4615, 0x5634,
0xd94c, 0xc96d, 0xf90e, 0xe92f, 0x99c8, 0x89e9, 0xb98a, 0xa9ab,
0x5844, 0x4865, 0x7806, 0x6827, 0x18c0, 0x08e1, 0x3882, 0x28a3,
0xcb7d, 0xdb5c, 0xeb3f, 0xfb1e, 0x8bf9, 0x9bd8, 0xabbb, 0xbb9a,
0x4a75, 0x5a54, 0x6a37, 0x7a16, 0x0af1, 0x1ad0, 0x2ab3, 0x3a92,
0xfd2e, 0xed0f, 0xdd6c, 0xcd4d, 0xbdaa, 0xad8b, 0x9de8, 0x8dc9,
0x7c26, 0x6c07, 0x5c64, 0x4c45, 0x3ca2, 0x2c83, 0x1ce0, 0x0cc1,
0xef1f, 0xff3e, 0xcf5d, 0xdf7c, 0xaf9b, 0xbfba, 0x8fd9, 0x9ff8,
0x6e17, 0x7e36, 0x4e55, 0x5e74, 0x2e93, 0x3eb2, 0x0ed1, 0x1ef0
};
WORD CRC16 (BYTE *Data, WORD length)
{
    WORD CRC_16 = 0xFFFF;
    WORD i;
    for (i = 0; i < length; i++)
    {
        CRC_16 = (CRC_16 << 8) ^ (crc_table[(CRC_16 >> 8) ^
(Data[i])]);
    }
    return CRC_16;
}
```

5 Send mode *Data output on request*

In send mode *Data output on request*, the measured data are requested by the host computer (e.g. block 12: Scan data). Send and fetch telegrams are used.

For send telegrams, the host computer sends the data to be transferred after the telegram header, the receiver answers with a reply telegram, which consists of a header only, without any additional data. For fetch telegrams, the host computer sends the header of a fetch telegram only, without additional data, the sensor answers with a reply telegram which contains the requested data after the telegram header.

The host computer is always the active node, even in an EFI system. The sensors themselves do not send RK512 telegrams. This means that there is no risk of possible initialization conflicts in the event of simultaneous communications.

5.1 Command telegram

The telegram head of the command telegram is comprised of 10 bytes, which have the following meaning:

Byte	Telegram fields	Contents	Meaning
1	Telegram identifier	0x00	
2		0x00	
3	Command telegram type	‘A’ (0x41) or ‘E’ (0x45)	Send telegram or Fetch telegram
4	Command data type	‘D’ (0x44)	Access to data sheet
5	Destination address/ Source address	0 to 255 (0x00 to 0xFF)	Block number
6		0 to 255 (0x00 to 0xFF)	Block index
7	Size	0 to 65535	Block size in data words
8			
9	Coordination flag	0xFF	
10	Device address	0x07 or 0x08	Host Guest

Table: Command telegram structure

5.2 Reply telegram

The telegram header of the reply telegram (reaction telegram) is comprised of 4 bytes, which have the following meaning:

Byte	Telegram fields	Contents	Meaning
1	Telegram identifier	0x00 (always)	
2		0x00 (always)	
3	Reply telegram type	0x00 (always)	Reply telegram
4	Reply error number	0x00 0x01 to 0xFF	No error See error table for error codes

Table: Reply telegram structure

5.2.1 Reply telegram error codes

The reply telegram is the reply to a send or fetch telegram given by the S3000/S300.

If the S3000/S300 detects a fault, it displays this by way of an error code in the reply telegram and no data will be sent after the reply telegram header.

Error code in reply telegram	Communications error in accordance with the RK512 protocol
0x00	No error.
0x01	The current status of the device allows no write access to the data block.
0x02	Access to data block not allowed for the current user group.
0x03	The password is incorrect.
0x04	The system token is occupied.
0x05	Parameter not correct.
	The target address block index or source address in the command telegram (byte 6) is impermissible (not defined in register interface).
0x06	The device is busy due to internal processes. Repeat the process for access to the data block.
	Internal device fault.
0x07	Access to data block not supported in current device mode.
0x0A	One of the communication monitors has failed (among other things timeout of EFI RK512 packets / EFI RK512 acknowledge or faulty transfer of EFI RK512 packets / EFI RK512 acknowledge).
0x0C	The coordination flag (byte number) in command telegram (byte 9) is not equal 0xFF.
	The device address in command telegram (byte 10, bit 0 to 3) is invalid (i.e. equals 0).
	The CPU number in command telegram (byte 10, bit 5 to 7) is impermissible.
0x10	The telegram identifier in command telegram (byte 1) is not equal 0x00 or 0xFF or is not followed by an additional byte 0x00 (byte 2).
	The command data type in command telegram (byte 4) is impermissible.
0x14	The data block number of the destination address or source address in command telegram (byte 5) is impermissible (not defined in register interface).
0x16	The command telegram type in command telegram (byte 3) is impermissible.
0x34	Telegram format error. Possible causes: • The length specified in the command telegram size field (byte 7 and 8) exceeds the available space in the data block for the specified address. • The length of send telegram data was greater than the length specified in the size field. • The length of send telegram data was less than the length specified in the size field. • A fetch telegram was received with user data. • The send telegram was correctly received, but the CRC value of the data is incorrect or the first six data bytes do not correspond to bytes 5 to 10 in the telegram header.

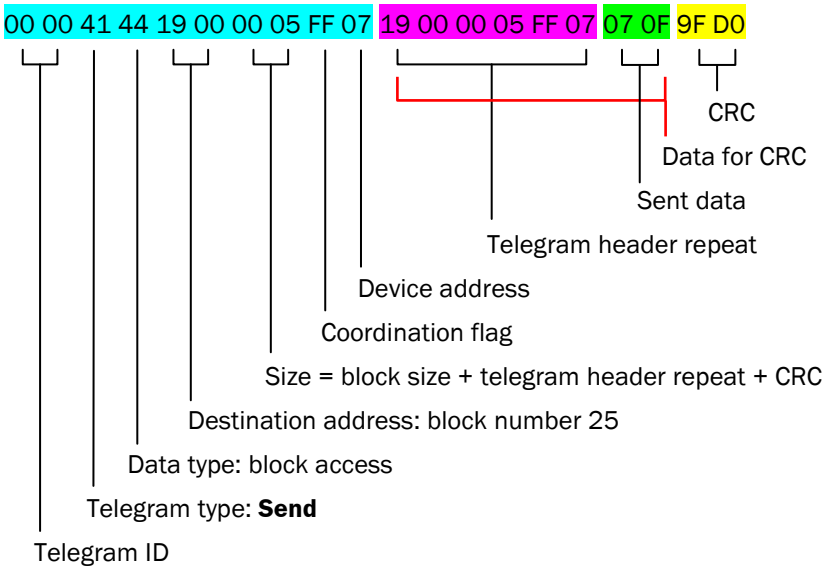
Error code in reply telegram	Communications error in accordance with the RK512 protocol
0x36	A command telegram was received although no reply telegram was sent for the previous command telegram.

Table: Reply telegram error codes

5.3 Standard communication

5.3.1 Example for a send telegram "Write token in block 25"

Host computer send

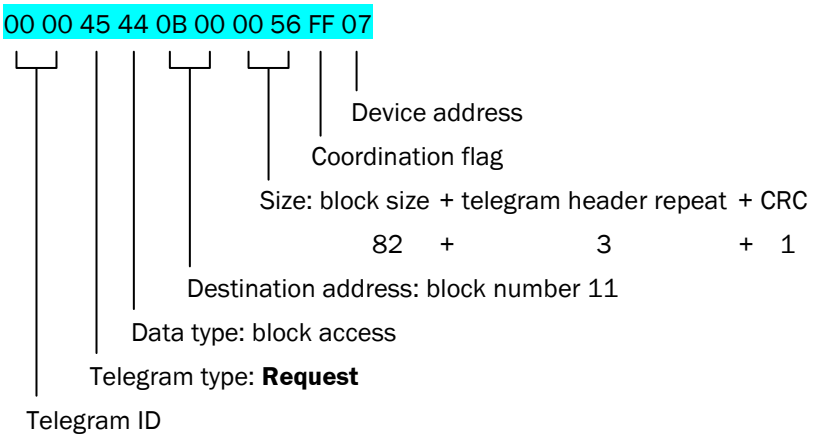


S3000 reply

00 00 00 00

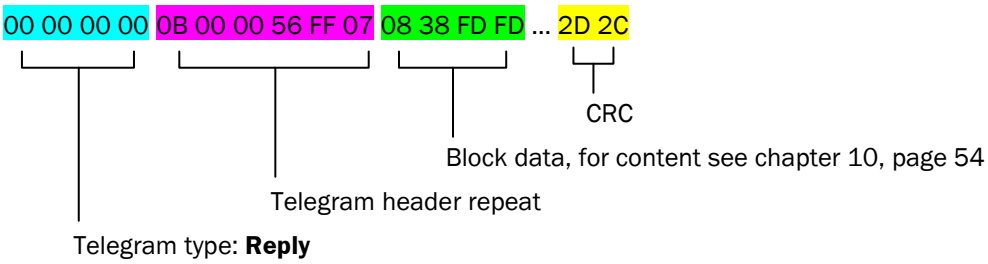
5.3.2 Example for a fetch telegram "Read operating data block 11"

Host computer send



S3000 reply

00 00 00 00 0B 00 00 56 FF 07 08 38 FD FD 00 02 00 55 00 00 00 00 00 08 7D 00 C0 02 00 00 35 01 00 00 52 00 61 04 00 00 9F 02 39 02 18 02 6A 00 0C 00 02 00 32 02 1B 00 1A 00 0A 00 49 02 02 00 28 00 14 00 23 02 01 00 04 00 0F 00 00 02 20 00 06 00 04 00 2A 02 1F 00 21 00 05 00 31 02 09 00 17 00 10 00 02 00 19 00 94 00 00 00 00 00 00 00 0A 00 0E 49 87 47 F6 4A 18 44 65 4E A7 00 9C 14 31 02 64 00 5A 00 A5 02 DE 02 07 01 69 01 6D 02 E8 02 A3 13 C3 00 F1 00 07 01 53 01 A6 01 34 02 03 03 3D 04 54 06 05 0A 98 00 C7 08 AC 08 2D 2C



5.4 Requesting data in send mode *Data output on request*

The S3000 and S300 support measured data blocks of static lengths (block 12), whereas the S3000 optionally supports flexible measured data block lengths (block 112).

For the S3000 with sensor head firmware ≥ B02.40 it is possible to request block 58 (for 0.5° scan resolution) or block 59 (for 0.25° scan resolution), once the resolution is configured. These blocks have a fixed length.

For the S300 with firmware ≥ 2.10 it is possible to request block 58 with static length.

Example 1: Only one S3000 is in use and measured data should be received.

1. Power on
2. Get token (send telegram with device address 0x07)
3. Read scan data record 1 (fetch telegram with device address 0x07)
4. Read scan data record 2 (fetch telegram with device address 0x07)
5. Read scan data record n (fetch telegram with device address 0x07)
6. Release token (send telegram with device address 0x07)

Example 2: There is an EFI system comprised of two S3000s and the system should alternately receive measured data from both scanners. There must be 2 separate RS-422 connections available.

1. Power on
2. Get token S3000 (host) (send telegram with device address 0x07)
3. Read scan data record from S3000 (host) (fetch telegram with device address 0x07)
4. Release token S3000 (host) (send telegram with device address 0x07)
5. Get token S3000 (guest) (send telegram with device address 0x08)
6. Read scan data record from S3000 (guest) (fetch telegram with device address 0x08)
7. Release token S3000 (guest) (send telegram with device address 0x08)

5.4.1 Example for communication in send mode *Data output on request*

Get token

Host computer send: 00 00 41 44 19 00 00 05 FF 07 19 00 00 05 FF 07 07 0F 9F D0

S3000 reply: 00 00 00 00

Read scan data (block 12)

Host computer send: 00 00 45 44 0C 00 02 FE FF 07

S3000 reply: 00 00 00 00 0C 00 02 FE FF 07 00 08 3B 00 3D 00 ... 00 00 FE E9

Read extended scan data (block 112)

Host computer send: 00 00 45 44 70 00 03 02 FF 07

S3000 reply: 00 00 00 00 70 00 03 02 FF 07 01 00 00 00 14 4B ... 29 00 26 8B

Read scan data 05 block (block 58)

Host computer send: 00 00 45 44 3A 00 01 8F FF 07

S3000 reply: 00 00 00 00 70 00 03 02 FF 07 01 00 00 00 07 00 ... 00 00 E1 C3

Read scan data 025 block (block 59)

Host computer send: 00 00 45 44 3B 00 03 0B FF 07

S3000 reply: 00 00 00 00 3B 00 03 0B FF 07 01 00 00 00 07 00 ... 00 00 C5 12

Release token

Host computer send: 00 00 41 44 19 00 00 05 FF 07 19 00 00 05 FF 07 00 00 E7 B8

S3000 reply: 00 00 00 00

5.5 Flexible telegram (S3000 only)

For some host computers, it is necessary to keep the interrupt load for the UART as low as possible. In such cases (in send mode *Data output on request)* it is possible to use a data block with flexible length in the reply telegram (block 112 instead of block).

Note Block 112 is only available from a directly connected (local) scanner. The output of the block from a second scanner, connected to a local scanner via EFI, is not possible.

6 Send mode *Continuous data output*

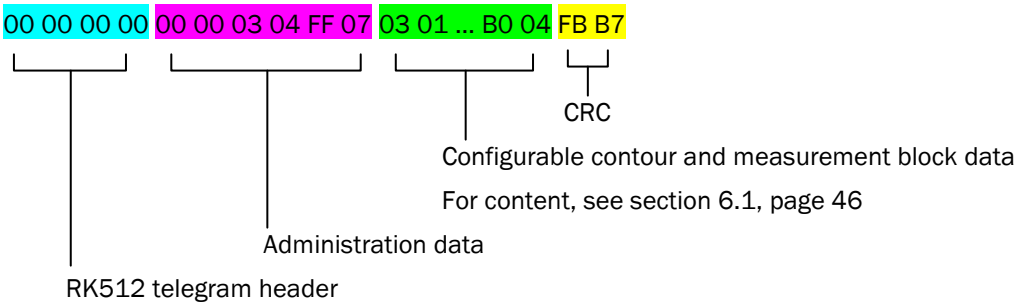
In order to create efficient telegram traffic, the S3000 and S300 can be configured in the CDS so that the measured values and certain additional information is permanently sent to the RS-422 interface. Continuous data output is not influenced by the telegram traffic via the other available interfaces. It is not necessary for continuous data output that the token is reserved for the RS-422 interface (in send mode *Data output on request,* only one interface at a time can own the token, see section 4.2 "System token" on page 38).

The measured data is output automatically in continuous data output mode, so that the telegrams only need to be read.

In send mode *Continuous data output* it is not possible to directly send a request telegram from the host computer. The host computer must first interrupt continuous data output (see section 6.5 "Stopping data output" on page 50).

Example: telegram structure for continuous data output

00 00 00 00 00 00 03 04 FF 07 03 01 00 00 17 01 00 00 00 00
BB BB 11 11 E8 03 E8 03 E8 03 ... B0 04 FB B7



Note In send mode *Continuous data output* the RS 422 interface can only output data from directly connected (local) scanners. The output of data from a second scanner, connected to a local scanner via EFI, is not possible.

6.1 Structure of continuous data output

6.1.1 Telegram header, administration data, general data

Data output always begins as follows:

00 00 00 00	4 Byte RK512 telegram header: Reply telegram
00 00	Data block number 0x0000 for continuous data output
xx xx	Size of telegram in 16-bit data words

S3000

The telegram size is calculated based on the data after the telegram header (starting with the first byte of the administration data, 5. byte of the telegram) up to and including the last byte of the telegram (incl. CRC). The length field thus shows the value: (total telegram length in bytes – 4)/2

S300: If I/O data and measuring ranges are not configured

The telegram size is calculated based on the data after the length field (starting with the 5. byte of the administration data, 9. byte of the telegram) up to and including the last byte of the telegram (incl. CRC). The length field thus shows the value:
(total telegram length in bytes – 8)/2

S300: If I/O data or at least one measuring range is configured

The telegram size is calculated based on the data after the protocol version within in the user data (starting with the 3. byte of the user data, 13. byte of the telegram)) up to and including the last byte of the user data (last byte bevore the CRC). The length field thus shows the value:
(total telegram length in bytes – 14)/2

S300: In compatibility mode

The telegram size is calculated based on the data after the telegram header (starting with the first byte of the administration data, 5. byte of the telegram) up to and including the last byte of the telegram (incl. CRC). The length field thus shows the value:
(total telegram length in bytes – 4)/2

FF 07 Coordination flag and device address, here 0x07 (host or standalone device)

03 01 Protocol version number: 0x0103

Deviation in compatibility mode: 02 01 Protocol version number: 0x0102

See section 6.2 "Protocol version number" on page 48 for detailed information.

00 00 or 01 00 Status normal 0x0000 or lockout 0x0001

17 01 00 00 Scan number (time stamp), here 0x00000117 (see section 7.1, page 51)

00 00 Telegram number, here 0x0000

6.1.2 Measured data (distance)

BB BB **ID for measured data**

11 11 ID for measured data from measuring range 1

xx xx Measured values from measuring range 1

...

Detailed information about data formats can be found under section 6.3 "Measured data formats" on page 48.

6.1.3 CRC

Subsequently the CRC value is output:

xx xx 16 Bit CRC

The CRC value is calculated based on the data after the telegram header (starting with the first byte of the administration data, 5. byte of the telegram) up to and including the last byte of the user data block (last byte before the CRC value).

6.2 Protocol version number

S3000/S300: 0x0103

In compatibility mode: S3000/S300: 0x0102

The protocol version number should be checked by the host computer. It is dependent on the firmware version on the sensor used and on whether compatibility mode is activated.

For other version numbers, the structure of continuous data output can vary.

6.3 Measured data formats

An explanation of the field designations used in the following tables can be found in section 7.2 "Designation of protective and warning fields" on page 51.

6.3.1 Data format of measured data for S3000 (2 Byte)

Bit 15 ... 13	Bit 12 ... 0
Status bits Bit 15: Interruption of field C or D detected (if the field is activated as a protective field) Bit 14: Interruption of field A or B detected (if the field is activated as a protective field) Bit 13: CMS models: Reflector detected Non-CMS models: Scanner dazzled **Deviations from this applicable to compatibility mode:** Bit 15: Measured value detected within simultaneous protective field Bit 14: Measured value detected within protective field	Measured distance in centimeters

6.3.2 Data format of measured data for S300 (2 Byte)

Bit 15 ... 13	Bit 12 ... 0
Status bits Bit 15: Firmware < 2.10: Measured value detected within warning field Firmware ≥ 2.10: 0 (fixed bit value) Bit 14: Measured value detected within protective field Bit 13: CMS models: Reflector detected Non-CMS models: Scanner dazzled	Measured distance in centimeters

6.4 Example for continuous data output with S3000

Configuration: output of all measured values

Output of all measured values from one complete scan, continuous data output, 0.25° angular resolution (120 ms basic response time)

Reception of one measured data record

...

00 00 00 00 00 00 03 04 FF 07 03 01 00 00 17 01 00 00 00 00 BB BB 11 11 E8 03 E8 03 E8 03 ... B0 04 FB B7

...

Explanation of the measured data record

00 00 00 00 4 Byte RK512 telegram header: Reply telegram

00 00 Data block number 0x0000 for continuous data output
03 04 Size of telegram in 16-bit data words: 772 data words
FF 07 Coordination flag and device address, here 0x07 (host or standalone device)

03 01 Protocol version number: 01.03

00 00 Status: normal

17 01 00 00 Scan number (time stamp): in this case 0x00000117 = 279

00 00 Telegram number: 0

BB BB ID for measured data

11 11 ID for measured data from measuring range 1 (complete scanning range, for S3000: 190°, for S300: 270°)

E8 03 Measured value 1 in current measuring range (at 0°, corresponds to –5° in S3000 coordinates system): 0x03E8,
in bit notation: 0000 0011 1110 1000
Bit 15: 0: no interruption of field C and D (if activated as protective field)
Bit 14: 0: no interruption of field A and B (if activated as protective field)
Bit 13: 0: scanner not dazzled
Bits 12 ... 0: distance in cm: 0x03E8 = 1000 [cm]
(512 cm + 256 cm + 128 cm + 64 cm + 32 cm + 8 cm = 1000 cm)

E8 03 Measured value 2 in current measuring range (at 0.25°, corresponds to –4.75° in S3000 coordinates system): 0x03E8,
in bit notation: 0000 0011 1110 1000
Bit 15: 0: no interruption of field C and D (if activated as protective field)
Bit 14: 0: no interruption of field A and B (if activated as protective field)
Bit 13: 0: scanner not dazzled
Bits 12 ... 0: distance in cm: 0x03E8 = 1000 [cm]

E8 03 Measured value 3 in current measuring range (at 0.5°, corresponds to –4.5° in S3000 coordinates system): 0x03E8,
in bit notation: 0000 0011 1110 1000
Bit 15: 0: no interruption of field C and D (if activated as protective field)
Bit 14: 0: no interruption of field A and B (if activated as protective field)
Bit 13: 0: scanner not dazzled
Bits 12 ... 0: distance in cm: 0x03E8 = 1000 [cm]

...

B0 04 Last measured value in current measuring range (value 761 at 190°, corresponds to 185° in S3000 coordinates system): 0x04B0,
in bit notation: 0000 0100 1011 0000
Bit 15: 0: no interruption of field C and D (if activated as protective field)
Bit 14: 0: no interruption of field A and B (if activated as protective field)
Bit 13: 1: scanner not dazzled
Bits 12 ... 0: distance in cm: 0x04B0 = 1200 [cm]

FB B7 16 Bit CRC

6.5 Stopping data output

In send mode *Continuous data output* it is not possible to directly send a request telegram from the host computer.

The host computer must first interrupt continuous data output. This is realized by sending code 0x41. Now the host computer can communicate in the same way as in *Data output on request* mode, as long as the configurable silent time has not elapsed. Subsequently the measured data output is automatically resumed.

Note Continuous data output is only undertaken in *Normal* and *Lockout system status*. In all other system states, the continuous data output is automatically deactivated.

6.6 Fixed configured modes for continuous data output

The CDS initially configures the measured data output so that it is fixed.

This configuration is retained permanently by the device until such time as a new configuration is transferred to the device.

Each switching-on operation causes this configuration to be loaded from the system plug memory.

7 Further information about measured data

7.1 Additional time stamps and telegram numbers

For moving vehicles, assignment of measured value records or reflector data records with a timestamp is necessary for the host computer in order that the measured value record can be evaluated with the right position and the right orientation of the vehicle. For this reason, in the sensor a global counter (32 bit) is realized, which is output with block 112 in send modes *Data output on request* (only S3000) and *Continuous data output*. This counter is internally incremented on each scan, in other words, every 40 ms (for S300) and depending on mode, every 30 ms or 60 ms (for S3000).

In addition, these blocks contain a unique telegram number, which is only incremented when the blocks are output.

7.2 Designation of protective and warning fields

The protective and warning fields are coded with letters A to D in the explanations to the telegrams. The assignment of these letters for protective and warning fields is explained in the following table:

Field	S3000 Dual Field mode	S3000 Triple Field mode	S3000 Four simultaneous protective fields	S300
A	Protective field	Protective field	Protective field 1	Protective field
B	Warning field	Warning field 1	Protective field 2	Warning field 1
C	Simultaneous protective field	–	Simultaneous protective field 1	–
D	Simultaneous warning field	Warning field 2	Simultaneous protective field 2	Warning field 2

In compatibility mode:

Field	S3000	S300
A	Protective field	Protective field
B	Warning field	Warning field
C	Simultaneous protective field	–
D	Simultaneous warning field	–

8 Fault diagnosis

The following options are available for diagnosing faults in the configuration of your sensor:

Blocks that have been changed online can be read back from the sensor at any time to check that the device settings are correct.

The following diagnostic options are available for use with the CDS:

- Display of configuration stored on device.
- Depiction of current sensor settings in operational status report.

9 Glossary

CDS	SICK Configuration & Diagnostic Software
Continuous data output	Permanent measured data send mode
Device address	Device address for communication
Diamond Grade	Reflector foil with respective optical characteristics
Direct hit	The complete area of a laser beam hits an object
EFI	see Enhanced Function Interface
Enhanced Function Interface	Safe SICK device communication
Measured data	Distance values measured by the sensor
Measuring range	Segment in scan field
Protocol version number	Firmware/device code for host computer
Raw speed data	Current measured incremental encoder values
Remote operation	Two S3000/S300 in EFI system
RK512 telegram header	Protocol definition for data communication
Scan data record	Distance values of a measuring cycle (0 to 190°/0 to 270°)
Silent time	Pause time for continuous data output
Time stamp	Time stamp determined at the time of data generation

10 Appendix

This appendix lists the data blocks that are relevant for using the measurement data of the S3000 (section 10.1) and S300 (section 10.2).

All data listed in this appendix are volatile, i. e. they are not maintained through power down.

Note Only for Compatibility mode: In this appendix, the term *Control Area A* refers to the active field set, while *Control Area B* refers to the active simultaneous field set. The term *Monitoring Area* refers to the configured field sets 0 ... (n – 1). Each field set may consist of one protective field and one or two warning fields. For details on field sets, see the operating instructions of the S3000/S300.

10.1 Description of the data blocks used in the S3000

10.1.1 Operating data block (block no. 11)

Block description

Data block name		Block no.	Block size	External access
Operating data block		11	164 Byte	Read only
	Block registers	Block words	Register size	Register description
	Operating mode	0	2 Byte	Operating mode of device
	Display data	1 ... 2	4 Byte	Actual display contents
	Input data	3 ... 4	4 Byte	Input data
	Output data	5	2 Byte	Output data
	Monitoring data	6	2 Byte	Monitoring data
	Configuration counter	7	2 Byte	Configuration counter info
	Device time-on	8 ... 9	4 Byte	Device time-on since last power-up
	Reserved for internal use	10 ... 81	132 Byte	Reserved

Register description

Register name	Block word	Field bits	Field name	Field description
Operating mode	0	0 ... 3	Device state	0: Normal 1: Configuration 2: Lockout 3: System initialization 4: Wait for valid inputs 5: Front screen calibration 6: Boot 7: Production 8: Wait for reset 9: Teach-in Other: n/u
		4	Device mode	0: Device is in regular mode 1: n/u
		5 ... 7	n/u	n/u

Register name	Block word	Field bits	Field name	Field description
		8 ... 10	Access level	Access level successfully set by external device. 0: Level 0 1: Level 1A 2: Level 1B 3: Level 2 4 :Level 3A 5: Level 3B 6: Level 4 7: n/u
		11 ... 12	Configuration state	0: Device not in configuration mode. 1: Configuration tool required. 2: Configuration in progress. 3: Configuration completed. Other: n/u
		13 ... 15	Active service interface	0: No interface active. 1: External serial interface. 2: Navigation data interface. 3: Enhanced Function Interface. Other: n/u
Display data	1	0	Displayed character 1 7-segment display: Segment a	0: Segment LED off 1: Segment LED on
		1	Displayed character 1 7-segment display: Segment b	0: Segment LED off 1: Segment LED on
		2	Displayed character 1 7-segment display: Segment c	0: Segment LED off 1: Segment LED on
		3	Displayed character 1 7-segment display: Segment d	0: Segment LED off 1: Segment LED on
		4	Displayed character 1 7-segment display: Segment e	0: Segment LED off 1: Segment LED on
		5	Displayed character 1 7-segment display: Segment f	0: Segment LED off 1: Segment LED on
		6	Displayed character 1 7-segment display: Segment g	0: Segment LED off 1: Segment LED on

Register name	Block word	Field bits	Field name	Field description
		7	Displayed character 1 7-segment display: Dot	0: Segment LED off 1: Segment LED on
		8 ... 15	Displayed character 2 [1]	See displayed character 1.
	2	0 ... 7	n/u	n/u
		8 ... 9	State of OSSD LEDs	0: Both LEDs off (Green OSSD LED off and Red OSSD LED off) 1: Green OSSD LED on (Red OSSD LED off) 2: Red OSSD LED on (Green OSSD LED off) 3: n/u
		10 ... 11	State of reset LED	0: LED off 1: LED blinking (1 Hz) 2: LED flashing (4 Hz) 3: LED on
		12 ... 13	State of weak LED	See state of reset LED.
		14 ... 15	State of warning field LED	See state of reset LED.
Input data	3	0	Reset of field A	0: Low 1: High
		1	Reset of field B	0: Low 1: High
		2	Reset of field C	0: Low 1: High
		3	Reset of field D	0: Low 1: High
		4	Standby	0: Low 1: High
		5	Operator acknowledge	0: Low 1: High
		6	EDM input	0: Low 1: High
		7	RES input	0: Low 1: High
		8	Input D2	0: Low 1: High
		9	Input D1	0: Low 1: High
		10	Input C2	0: Low 1: High
		11	Input C1	0: Low 1: High
		12	Input B2	0: Low 1: High
		13	Input B1	0: Low 1: High

[1] On the device, there is only one 7-segment display. Therefore the representation of the two digits is as follows: Constant indication of a character represents a single character. Flashing indication of a character represents two identical characters. Alternating indication of two characters represents two different characters.

Register name	Block word	Field bits	Field name	Field description
		14	Input A2	0: Low 1: High
		15	Input A1	0: Low 1: High
	4	0 ... 15	Speed	–2000 ... 2000 [cm/s] 0x7FFF: Speed is not evaluated. Other: n/u
Output data	5	0	State of OSSDs	0: Deactivated 1: Activated
		1	State of auxiliary output 3	0: Output voltage level high (24 V). 1: Output voltage level low (0 V).
		2 ... 3	State of auxiliary output 2	0: Output voltage level high (24 V). 1: Toggling slowly (1 Hz). 2: n/u 3: Output voltage level low (0 V).
		4 ... 5	State of auxiliary output 1	0: Output voltage level high (24 V). 1: Toggling slowly (1 Hz). 2: Toggling fast (4 Hz). 3: Output voltage level low (0 V).
		6 ... 7	n/u	n/u
		8	Field A	Intrusion detected by field evaluation A. 0: Intrusion detected. 1: No intrusion detected.
		9	Field B	Intrusion detected by field evaluation B. 0: Intrusion detected. 1: No intrusion detected.
		10	Field C	Intrusion detected by field evaluation C. 0: Intrusion detected. 1: No intrusion detected.
		11	Field D	Intrusion detected by field evaluation D. 0: Intrusion detected. 1: No intrusion detected.
		12	Reset required field A	Reset required by field evaluation A. 0: No reset required. 1: Reset required.
		13	Reset required field B	Reset required by field evaluation B. 0: No reset required. 1: Reset required.
		14	Reset required field C	Reset required by field evaluation C. 0: No reset required. 1: Reset required.
		15	Reset required field D	Reset required by field evaluation D. 0: No reset required. 1: Reset required.

Register name	Block word	Field bits	Field name	Field description
Monitoring data	6	0 ... 4	Monitoring case	0 ... 31: Active monitoring case
		5	Standby	Standby mode flag 0: No standby 1: Standby
		6 ... 7	n/u	n/u
		8 ... 10	Control area A	0 ... 7: Monitoring area of control area A Only used in compatibility mode, otherwise control area A is always 0 (no support of monitoring of control areas).
		11	Control area A activated	0: Control area A inactive 1: Control area A active Only used in compatibility mode, otherwise the flag is always false (no support of monitoring of control areas).
		12 ... 14	Control area B	0 ... 7: Monitoring area of control area B Only used in compatibility mode, otherwise control area B is always 0 (no support of monitoring of control areas).
		15	Control area B activated	0: Control area B inactive 1: Control area B active Only used in compatibility mode, otherwise the flag is always false (no support of monitoring of control areas).
Configuration counter	7	0 ... 15	Configuration counter	0: Initial state of connector plug Other: Number of configurations stored in connector plug so far
Device time-on	8 ... 9	0 ... 31	Device time-on	Time-on of the device since power-up [s]
Reserved for internal use	10 ... 81			

10.1.2 Scan data block (block no. 12)

Block description

Data block name		Block no.	Block size	External access
Scan data block		12	1524 Byte	Read only
	Block registers	Block words	Register size	Register description
	Monitoring data	0	2 Byte	Monitoring data
	Scan data pulse 0 ... 760	1 ... 761	1522 Byte	Measurement data per pulse

Register description

Register name	Block word	Field bits	Field name	Field description
Monitoring data	0	0 ... 4	Monitoring case	0 ... 31: Active monitoring case
		5	Standby	Standby mode flag 0: No standby 1: Standby
		6 ... 7	n/u	n/u
		8 ... 10	Control area A	0 ... 7: Monitoring area of control area A Only used in compatibility mode, otherwise control area A is always 0 (no support of monitoring of control areas).
		11	Control area A activated	0: Control area A inactive 1: Control area A active Only used in compatibility mode, otherwise the flag is always false (no support of monitoring of control areas).
		12 ... 14	Control area B	0 ... 7: Monitoring area of control area B Only used in compatibility mode, otherwise control area B is always 0 (no support of monitoring of control areas).
		15	Control area B activated	0: Control area B inactive 1: Control area B active Only used in compatibility mode, otherwise the flag is always false (no support of monitoring of control areas).

Register name	Block word	Field bits	Field name	Field description
Scan data pulse 0	1	0 ... 12	Distance	Distance [cm]
		13	Status flag 1	CMS variants: Reflector detected. Non-CMS variants: Measurement was glared.
		14	Status flag 2	Intrusion detected in field evaluation A or B (if activated for evaluation of protective field/ collision protection field). **In compatibility mode:** Measured value detected within protective field
		15	Status flag 3	Intrusion detected in field evaluation C or D (if activated for evaluation of protective field/ collision protection field). **In compatibility mode:** Measured value detected within simultaneous protective field
Scan data pulse 1 ... 760	2 ... 761	See scan data pulse 0.		

10.1.3 Config master block (block no. 25)

Block description

Data block name	Block no.	Block size	External access
Config master block	25	2 Byte	Read Write

Block registers	Block words	Register size	Register description
Master ID	0	2 Byte	Master identification

Register description

Register name	Block word	Field bits	Field name	Field description
Master ID	0	0 ... 15	Token	0x0000:Token not assigned. Other: Token assigned to some interface.

Remark:

In order to request the token, write some number > 0 to the Master ID register.

In order to return the token, write 0x0000 to the Master ID register.

10.1.4 Scan data 05 block (block no. 58)

The scan data can be accessed if the device is operating with a resolution of 0.5°.

Block description

Data block name	Block no.	Block size	External access
Scan data 05 block	58	790 Byte	Read only

Block registers	Block words	Register size	Register description
Processing	0	2 Byte	Information about the current processing status
Display	1 ... 2	4 Byte	Display setting
Input data	3 ... 4	4 Byte	Input data
Output data	5	2 Byte	Output data
Speed data	6 ... 8	6 Byte	Speed data
Error info	9	2 Byte	Error or info
Field evaluation A	10	2 Byte	Status of field evaluation A
Field evaluation B ... D	11 ... 13	6 Byte	Status of field evaluation B ... D
Pulse 0	14	2 Byte	Information about the measurement of pulse 0
Pulse 1 ... 380	15 ... 394	760 Byte	Information about the measurement of pulses 1 ... 380

Register description

Register name	Block word	Field bits	Field name	Field description
Processing	0	0 ... 4	Active Case	0 ... 31: Active monitoring case
		5	StandBy	0: No standby 1: Device in standby
		6 ... 15	n/u	n/u
Display	1 ... 2	0	Displayed character 1 7-segment display: Segment a	0: Segment LED off 1: Segment LED on
		1	Displayed character 1 7-segment display: Segment b	0: Segment LED off 1: Segment LED on
		2	Displayed character 1 7-segment display: Segment c	0: Segment LED off 1: Segment LED on
		3	Displayed character 1 7-segment display: Segment d	0: Segment LED off 1: Segment LED on
		4	Displayed character 1 7-segment display: Segment e	0: Segment LED off 1: Segment LED on

Register name	Block word	Field bits	Field name	Field description
		5	Displayed character 1 7-segment display: Segment f	0: Segment LED off 1: Segment LED on
		6	Displayed character 1 7-segment display: Segment g	0: Segment LED off 1: Segment LED on
		7	Displayed character 1 7-segment display: Dot	0: Segment LED off 1: Segment LED on
		8 ... 15	Displayed character 2 [2]	See displayed character 1.
		16 ... 23	n/u	n/u
		24 ... 25	State of OSSD LEDs	0: Both LEDs off (Green OSSD LED off and Red OSSD LED off) 1: Green OSSD LED on (Red OSSD LED off) 2: Red OSSD LED on (Green OSSD LED off) 3: n/u
		26 ... 27	State of reset LED	0: LED off 1: LED blinking (1 Hz) 2: LED flashing (4 Hz) 3: LED on
		28 ... 29	State of weak LED	See state of reset LED
		30 ... 31	State of warning field LED	See state of reset LED
Input data	3 ... 4	0	Reset of field A	0: Low 1: High
		1	Reset of field B	0: Low 1: High
		2	Reset of field C	0: Low 1: High
		3	Reset of field D	0: Low 1: High
		4	Standby	0: Low 1: High
		5	Operator acknowledge	0: Low 1: High
		6	EDM input	0: Low 1: High
		7	RES input	0: Low 1: High
		8	Input D2	0: Low 1: High
		9	Input D1	0: Low 1: High

[2] On the device, there is only one 7-segment display. Therefore the representation of the two digits is as follows: Constant indication of a character represents a single character. Flashing indication of a character represents two identical characters. Alternating indication of two characters represents two different characters.

Register name	Block word	Field bits	Field name	Field description
		10	Input C2	0: Low 1: High
		11	Input C1	0: Low 1: High
		12	Input B2	0: Low 1: High
		13	Input B1	0: Low 1: High
		14	Input A2	0: Low 1: High
		15	Input A1	0: Low 1: High
		16 ... 31	Speed	–2000 ... 2000 [cm/s] (two's-complement representation) 0x7FFF: Speed is not evaluated. Other: n/u
Output data	5	0	State of OSSDs	0: Deactivated 1: Activated
		1	State of auxiliary output 3	0: Output voltage level high (24 V) 1: Output voltage level low (0 V)
		2 ... 3	State of auxiliary output 2	0: Output voltage level high (24 V) 1: Toggling slowly (1 Hz) 2: n/u 3: Output voltage level low (0 V)
		4 ... 5	State of auxiliary output 1	0: Output voltage level high (24 V) 1: Toggling slowly (1 Hz) 2: Toggling fast (4 Hz) 3: Output voltage level low (0 V)
		6 ... 7	n/u	n/u
		8	Field A	Intrusion detected by field evaluation A. 0: Intrusion detected. 1: No intrusion detected.
		9	Field B	Intrusion detected by field evaluation B. 0: Intrusion detected. 1: No intrusion detected.
		10	Field C	Intrusion detected by field evaluation C. 0: Intrusion detected. 1: No intrusion detected.
		11	Field D	Intrusion detected by field evaluation D. 0: Intrusion detected. 1: No intrusion detected.
		12	Reset required field A	Reset required by field evaluation A. 0: No reset required. 1: Reset required.

Register name	Block word	Field bits	Field name	Field description
		13	Reset required field B	Reset required by field evaluation B. 0: No reset required. 1: Reset required.
		14	Reset required field C	Reset required by field evaluation C. 0: No reset required. 1: Reset required.
		15	Reset required field D	Reset required by field evaluation D. 0: No reset required. 1: Reset required.
Speed data	6 ... 8	0 ... 15	Speed inc 1	Speed of incremental encoder 1: –2000 ... 2000 [cm/s] (two's-complement representation)
		16 ... 31	Speed inc 2	Speed of incremental encoder 2: –2000 ... 2000 [cm/s] (two's-complement representation)
		32	Input E2	0: Low 1: High
		33	Input E1	0: Low 1: High
		34 ... 46	n/u	n/u
		47	Speed status	Status of speed information: 0: The speed information is invalid. 1: The speed information is valid.
Error info	9	0 ... 15	Error code	Lockout error or info code
Field evaluation A	10	0 ... 5	Monitoring field number	0 ... 63: Monitoring field number of field assigned to field evaluation A
		6 ... 7	Monitoring field type	0: Protective field 1: Warning field 2: n/u 3: Inactive field
		8 ... 15	Multiple scan evaluation	0 ... 255: Number of scans that an object has to be detected as intrusion to set the status of the field to “intruded”.
Field evaluation B ... D	11 ... 13	See field evaluation A.		

Register name	Block word	Field bits	Field name	Field description
Pulse 0	14	0 ... 12	Distance	Distance [cm]
		13	Status flag 1	CMS variants: Reflector detected. Non-CMS variants: Measurement was glared.
		14	Status flag 2	Intrusion detected in field evaluation A or B (if activated for evaluation of protective field/ collision protection field). **In compatibility mode:** Measured value detected within protective field.
		15	Status flag 3	Intrusion detected in field evaluation C or D (if activated for evaluation of protective field/ collision protection field). **In compatibility mode:** Measured value detected within simultaneous protective field.
Pulse 1 ... 380	15 ... 394	See pulse 0.		

10.1.5 Scan data 025 block (block no. 59)

The scan data can be accessed if the device is operating with a resolution of 0.25°.

Block description

Data block name		Block no.	Block size	External access
Scan data 025 block		59	1550 Byte	Read only
	Block registers	Block words	Register size	Register description
	Processing	0	2 Byte	Information about the current processing status
	Display	1 … 2	4 Byte	Display setting
	Input data	3 … 4	4 Byte	Input data
	Output data	5	2 Byte	Output data
	Speed data	6 … 8	6 Byte	Speed data
	Error info	9	2 Byte	Error or info
	Field evaluation A	10	2 Byte	Status of field evaluation A
	Field evaluation B … D	11 … 13	6 Byte	Status of field evaluation B … D
	Pulse 0	14	2 Byte	Information about the measurement of pulse 0
	Pulse 1 … 760	15 … 774	1520 Byte	Information about the measurement of pulses 1 … 760

Register description

Register name	Block word	Field bits	Field name	Field description
Processing	0	0 … 4	Active case	0 … 31: Active monitoring case
		5	Standby	0: No standby 1: Device in standby
		6 … 15	n/u	n/u
Display	1 … 2	0	Displayed character 1 7-segment display: Segment a	0: Segment LED off 1: Segment LED on
		1	Displayed character 1 7-segment display: Segment b	0: Segment LED off 1: Segment LED on
		2	Displayed character 1 7-segment display: Segment c	0: Segment LED off 1: Segment LED on
		3	Displayed character 1 7-segment display: Segment d	0: Segment LED off 1: Segment LED on
		4	Displayed character 1 7-segment display: Segment e	0: Segment LED off 1: Segment LED on

Register name	Block word	Field bits	Field name	Field description
		5	Displayed character 1 7-segment display: Segment f	0: Segment LED off 1: Segment LED on
		6	Displayed character 1 7-segment display: Segment g	0: Segment LED off 1: Segment LED on
		7	Displayed character 1 7-segment display: Dot	0: Segment LED off 1: Segment LED on
		8 ... 15	Displayed character 2 [3]	See displayed character 1.
		16 ... 23	n/u	n/u
		24 ... 25	State of OSSD LEDs	0: Both LEDs off (Green OSSD LED off and red OSSD LED off). 1: Green OSSD LED on (Red OSSD LED off). 2: Red OSSD LED on (Green OSSD LED off). 3: n/u
		26 ... 27	State of reset LED	0: LED off. 1: LED blinking (1 Hz). 2: LED flashing (4 Hz). 3: LED on.
		28 ... 29	State of weak LED	See state of reset LED.
		30 ... 31	State of warning field LED	See state of reset led.
Input data	3 ... 4	0	Reset of field A	0: Low 1: High
		1	Reset of field B	0: Low 1: High
		2	Reset of field C	0: Low 1: High
		3	Reset of field D	0: Low 1: High
		4	Standby	0: Low 1: High
		5	Operator acknowledge	0: Low 1: High
		6	EDM input	0: Low 1: High
		7	RES input	0: Low 1: High
		8	Input D2	0: Low 1: High
		9	Input D1	0: Low 1: High

[3] On the device, there is only one 7-segment display. Therefore the representation of the two digits is as follows: Constant indication of a character represents a single character. Flashing indication of a character represents two identical characters. Alternating indication of two characters represents two different characters.

Register name	Block word	Field bits	Field name	Field description
		10	Input C2	0: Low 1: High
		11	Input C1	0: Low 1: High
		12	Input B2	0: Low 1: High
		13	Input B1	0: Low 1: High
		14	Input A2	0: Low 1: High
		15	Input A1	0: Low 1: High
		16 ... 31	Speed	–2000 ... 2000 [cm/s] (two's-complement representation) 0x7FFF: Speed is not evaluated. Other: n/u
Output data	5	0	State of OSSDs	0: Deactivated 1: Activated
		1	State of auxiliary output 3	0: Output voltage level high (24 V) 1: Output voltage level low (0 V)
		2 ... 3	State of auxiliary output 2	0: Output voltage level high (24 V) 1: Toggling slowly (1 Hz) 2: n/u 3: Output voltage level low (0 V)
		4 ... 5	State of auxiliary output 1	0: Output voltage level high (24 V) 1: Toggling slowly (1 Hz) 2: Toggling fast (4 Hz) 3: Output voltage level low (0 V)
		6 ... 7	n/u	n/u
		8	Field A	Intrusion detected by field evaluation A. 0: Intrusion detected. 1: No intrusion detected.
		9	Field B	Intrusion detected by field evaluation B. 0: Intrusion detected. 1: No intrusion detected.
		10	Field C	Intrusion detected by field evaluation C. 0: Intrusion detected. 1: No intrusion detected.
		11	Field D	Intrusion detected by field evaluation D. 0: Intrusion detected. 1: No intrusion detected.
		12	Reset required field A	Reset required by field evaluation A. 0: No reset required. 1: Reset required.

Register name	Block word	Field bits	Field name	Field description
		13	Reset required field B	Reset required by field evaluation B. 0: No reset required. 1: Reset required.
		14	Reset required field C	Reset required by field evaluation C. 0: No reset required. 1: Reset required.
		15	Reset required field D	Reset required by field evaluation D. 0: No reset required. 1: Reset required.
Speed data	6 ... 8	0 ... 15	Speed inc 1	Speed of incremental encoder 1: –2000 ... 2000 [cm/s] (two's-complement representation)
		16 ... 31	Speed inc 2	Speed of incremental encoder 2: –2000 ... 2000 [cm/s] (two's-complement representation)
		32	Input E2	0: Low 1: High
		33	Input E1	0: Low 1: High
		34 ... 46	n/u	n/u
		47	Speed status	Status of speed information: 0: The speed information is invalid. 1: The speed information is valid.
Error info	9	0 ... 15	Error code	Lockout error or info code
Field evaluation A	10	0 ... 5	Monitoring field number	0 ... 63: Monitoring field number of field assigned to field evaluation A
		6 ... 7	Monitoring field type	0: Protective field 1: Warning field 2: n/u 3: Inactive field
		8 ... 15	Multiple scan evaluation	0 ... 255: Number of scans that an object has to be detected as intrusion to set the status of the field to “intruded”.
Field evaluation B ... D	11 ... 13	See field evaluation A.		

Register name	Block word	Field bits	Field name	Field description
Pulse 0	14	0 ... 12	Distance	Distance [cm]
		13	Status flag 1	CMS variants: Reflector detected. Non-CMS variants: Measurement was glared.
		14	Status flag 2	Intrusion detected in field evaluation A or B (if activated for evaluation of protective field/ collision protection field). **In compatibility mode:** Measured value detected within protective field.
		15	Status flag 3	Intrusion detected in field evaluation C or D (if activated for evaluation of protective field/ collision protection field). **In compatibility mode:** Measured value detected within simultaneous protective field.
Pulse 1 ... 760	15 ... 774	See pulse 0.		

10.1.6 Extended scan data block (block no. 112)

Block description

Data block name	Block no.	Block size	External access
Extended scan data block	112	772 or 1532 Byte	Read only

Block registers	Block words	Register size	Register description
Telegram number	0 ... 1	4 Byte	Telegram number
Scan number	2 ... 3	4 Byte	Scan number
Monitoring data	4	2 Byte	Monitoring data
Scan data pulse 0 ... 380 or 0 ... 760	5 ... 765	762 or 1522 Byte	Scan data per pulse

Register description

Register name	Block word	Field bits	Field name	Field description
Telegram number	0 ... 1	0 ... 31	Telegram number	Current telegram number
Scan number	2 ... 3	0 ... 31	Scan number	Scan number since power-up
Monitoring data	4	0 ... 4	Monitoring case	0 ... 31: Active monitoring case
		5	Standby	0: No standby 1: Standby operation
		6 ... 7	n/u	n/u
		8 ... 10	Control area A	0 ... 7: Monitoring area of control area A Only used in compatibility mode, otherwise control area A is always 0 (no support of monitoring of control areas).
		11	Control area A activated	0: Control area A inactive 1: Control area A active Only used in compatibility mode, otherwise the flag is always false (no support of monitoring of control areas).
		12 ... 14	Control area B	0 ... 7: Monitoring area of control area B Only used in compatibility mode, otherwise control area B is always 0 (no support of monitoring of control areas).
		15	Control area B activated	0: Control area B inactive 1: Control area B active Only used in compatibility mode, otherwise the flag is always false (no support of monitoring of control areas).

Register name	Block word	Field bits	Field name	Field description
Scan data pulse 0	5	0 ... 12	Distance	Distance [cm]
		13	Status flag 1	CMS variants: Reflector detected. Non-CMS variants: Measurement was glared.
		14	Status flag 2	Intrusion detected in field evaluation A or B (if activated for evaluation of protective field/ collision protection field). **In compatibility mode:** Measured value detected within protective field.
		15	Status flag 3	Intrusion detected in field evaluation C or D (if activated for evaluation of protective field/ collision protection field). **In compatibility mode:** Measured value detected within simultaneous protective field.
Scan data pulse 1 ... 380 or 1 ... 760	6 ... 385 or 6 ... 765	See scan data pulse 0.		

Note The actual size of the telegram depends on the scan resolution.

10.2 Description of the data blocks used in the S300

10.2.1 Operating data block (block no. 11)

Block description

Data block name	Block no.	Block size	External access
Operating data block	11	238 Byte	Read only

Register description

Register name	Block word	Field bits	Field name	Field description
Operating mode	0	0 ... 3	Device state	0: Normal 1: Configuration 2: Lockout 3: System initialization 4: Wait for valid inputs 5: Front screen calibration 7: Production 8: Wait for reset
		4 ... 5	Measurement state	Actual state of measurement kernel 0: Initialization state 1: Testgate measurement state 2: Reference measurement state 3: Measurement kernel ready
		6	Device mode	0: Device is in standard mode 1: ScannerIQ mode is active.
		7	n/u	n/u
		8 ... 10	Access level	Access level successfully set by external device. 0: Level 0 1: Level 1A 2: Level 1B 3: Level 2 4 :Level 3A 5: Level 3B 6: Level 4
		11 ... 12	Configuration state	0: Device not in configuration mode. 1: Configuration tool required. 2: Configuration in progress. 3: Configuration completed.
		13 ... 15	Active service interface	0: No interface active. 1: External serial interface. 2: Navigation data interface. 3: Enhanced Function Interface.
Display data	1	0 ... 7	Displayed character 1	Bit 0:Segment LED a Bit 1: Segment LED b ... Bit 6: Segment LED g Bit 7: Segment dot LED

Register name	Block word	Field bits	Field name	Field description
		8 ... 15	Displayed character 2 [4]	See displayed character 1.
	2	0 ... 7	Displayed character 3	Always 0 (empty character)
		8 ... 9	State of OSSD LEDs	0: n/u 1: Green OSSD LED on (Red OSSD LED off) 2: Red OSSD LED on (Green OSSD LED off) 3: n/u
		10 ... 11	State of reset LED	0: LED off 1: LED blinking (1 Hz) 2: LED flashing (4 Hz) 3: LED on
		12 ... 13	State of weak LED	See state of reset LED
		14 ... 15	State of warning field LED	See state of reset LED
Input data	3	0	Input aux 1	Auxiliary input 1 0: Low state 1: High state
		1	Input aux 2	Auxiliary input 2 0: Low state 1: High state
		2	Input aux 3	Auxiliary input 3 0: Low state 1: High state
		3 ... 4	n/u	n/u
		5	Parkmode input	0: Low 1: High
		6	EDM input	0: Low 1: High
		7	RES input	0: Low 1: High
		8	Input D2	0: Low 1: High
		9	Input D1	0: Low 1: High
		10	Input C2	0: Low 1: High
		11	Input C1	0: Low 1: High
		12	Input B2	0: Low 1: High
		13	Input B1	0: Low 1: High
		14	Input A2	0: Low 1: High
		15	Input A1	0: Low 1: High

[4] On the device, there is only one 7-segment display. Therefore the representation of the two digits is as follows: Constant indication of a character represents a single character. Flashing indication of a character represents two identical characters. Alternating indication of two characters represents two different characters.

Register name	Block word	Field bits	Field name	Field description
	4	0 ... 15	Speed	–2000 ... 2000 [cm/s] (two's-complement representation) 0x0000: Speed is not evaluated. **In compatibility mode:** 0x7FFF: Speed is not evaluated. Other: n/u (Consider speed valid flag!)
Output data	5	0	State of OSSDs	0: Deactivated (red) 1: Activated (green)
		1	State of warning output or aux 3	0: Deactivated (red) 1: Activated (green)
		2 ... 3	State of reset required output or aux 2	0: Deactivated (off) 1: Toggling slowly (1 Hz) 2: Toggling fast (4 Hz 3: Activated (on)
		4 ... 5	State of error/weak output or aux 1	0: Deactivated (off), not configured or contamination error. 1: Toggling slowly (1 Hz), contamination warning. 2: Toggling fast (4 Hz), lockout. 3: Activated (on), configured and no lockout or contamination error.
		6 ... 7	n/u	n/u
		8	Field A	Intrusion detected by field evaluation A. 0: Intrusion detected. 1: No intrusion detected.
		9	Field B	Intrusion detected by field evaluation B. 0: Intrusion detected. 1: No intrusion detected.
		10	Field C	Intrusion detected by field evaluation C. 0: Intrusion detected. 1: No intrusion detected.
		11	Field D	Intrusion detected by field evaluation D. 0: Intrusion detected. 1: No intrusion detected.
		12	Reset required field A	Reset required by field evaluation A. 0: No reset required. 1: Reset required.
		13	Reset required field B	Reset required by field evaluation B. 0: No reset required. 1: Reset required.
		14	Reset required field C	Reset required by field evaluation C. 0: No reset required. 1: Reset required.

Register name	Block word	Field bits	Field name	Field description
		15	Reset required field D	Reset required by field evaluation D. 0: No reset required. 1: Reset required.
Monitoring data	6	0 … 4	Monitoring case	0 … 31: Active monitoring Case
		5 … 6	n/u	n/u
		7	Standby	Device is in standby mode.
		8 … 12	Control area A	0 … 31: Standard: Active control area Enhanced [5]: Active protective field
		13 … 15	n/u	n/u
Configuration counter	7	0 … 15	Configuration counter	0: Initial state of connector plug Other: Number of configurations stored in connector plug so far
Device time-on	8 … 9	0 … 31	Device time-on	Time-on of the device since power-up [s]
Reserved for internal use	10 … 118			

[5] Only with S300 Expert in Compatibility mode with resolution configured to 1°.

10.2.2 Scan data block (block no. 12)

Block description

Data block name	Block no.	Block size	External access
Scan data block	12	1084 Byte	Read only

Register description

Register name	Block word	Field bits	Field name	Field description
Monitoring data	0	0 ... 3	Monitoring case	0 ... 15: Active monitoring case
		4 ... 7	n/u	n/u
		8 ... 12	Control area	0 ... 19: Standard: active control area Enhanced [6]: active protective field
		13 ... 15	n/u	n/u
Scan data pulse 0	1	0 ... 12	Distance	Distance [cm]
		13	Status flag 1	CMS variants: Reflector detected. Non-CMS variants: Measurement was glared.
		14	Status flag 2	Intrusion detected in protective field (field evaluation A).
		15	Status flag 3	Firmware < 2.10: Intrusion detected in warning field. Firmware ≥ 2.10: n/u
Scan data pulse 1 ... 540	1 ... 540	See scan data pulse 0.		

[6] Only with S300 Expert in Compatibility mode with resolution configured to 1°.

10.2.3 Config master block (block no. 25)

Block description

Data block name	Block no.	Block size	External access
Config master block	25	2 Byte	Read Write

Register description

Register name	Block word	Field bits	Field name	Field description
Master ID register	0	0 ... 15	Token	0x0000: Token not assigned. Other: Token assigned to some interface.

Remark:

In order to request the token, write some number > 0 to the Master ID register.

In order to return the token, write 0x0000 to the Master ID register.

10.2.4 Scan data 05 block (block no. 58)

Block description

Data block name	Block no.	Block size	External access
Scan data 05 block	58	1110 Byte	Read only

Block registers	Block words	Register size	Register description
Processing	0	2 Byte	Information about the current processing status
Display	1 ... 2	4 Byte	Display content
Input data	3 ... 4	4 Byte	Input data
Output states	5	2 Byte	Output data
Speed data	6 ... 8	6 Byte	Speed data
Error info	9	2 Byte	Error or info
Field evaluation A	10	2 Byte	Status of field evaluation A
Field evaluation B ... D	11 ... 13	6 Byte	Status of field evaluation B ... D
Pulse 0	14	2 Byte	Information about the measurement of pulse 0
Pulse 1 ... 540	15 ... 554	1080 Byte	Information about the measurement of pulses 1 ... 540

Register description

Register name	Block word	Field bits	Field name	Field description
Processing	0	0 ... 4	Active case	0 ... 31: Active monitoring case
		5	Standby	0: No standby 1: Device in standby
		6 ... 15	n/u	n/u
Display	1 ... 2	0	Displayed character 1 7-segment display: Segment a	0: Segment LED off 1: Segment LED on
		1	Displayed character 1 7-segment display: Segment b	0: Segment LED off 1: Segment LED on
		2	Displayed character 1 7-segment display: Segment c	0: Segment LED off 1: Segment LED on
		3	Displayed character 1 7-segment display: Segment d	0: Segment LED off 1: Segment LED on
		4	Displayed character 1 7-segment display: Segment e	0: Segment LED off 1: Segment LED on

Register name	Block word	Field bits	Field name	Field description
		5	Displayed character 1 7-segment display: Segment f	0: Segment LED off 1: Segment LED on
		6	Displayed character 1 7-segment display: Segment g	0: Segment LED off 1: Segment LED on
		7	Displayed character 1 7-segment display: Dot	0: Segment LED off 1: Segment LED on
		8 ... 15	Displayed character 2 [7]	See displayed character 1.
		16 ... 23	Displayed character 3	Always 0 (empty character)
		24 ... 25	State of OSSD LEDs	0: n/u 1: Green OSSD LED on (Red OSSD LED off) 2: Red OSSD LED on (Green OSSD LED off) 3: n/u
		26 ... 27	Reset Required LED	State of reset required LED: 0: LED off 1: LED blinking (1 Hz) 2: LED flashing (4 Hz) 3: LED on
		28 ... 29	Weak LED	State of weak LED: See state of reset LED.
		30 ... 31	Warn LED	State of Warn LED: See state of reset LED.
Input data	3 ... 4	0	Input aux 1	Auxiliary Input 1: 0: Low 1: High
		1	Input aux 2	Auxiliary Input 2: 0: Low 1: High
		2	Input aux 3	Auxiliary Input 3: 0: Low 1: High
		3 ... 4	n/u	n/u
		5	Input park mode	Park mode input 0: Low 1: High
		6	Input EDM	EDM input: 0: Low 1: High
		7	Input reset	Reset input: 0: Low 1: High
		8	Input D2	0: Low 1: High

[7] On the device, there is only one 7-segment display. Therefore the representation of the two digits is as follows: Constant indication of a character represents a single character. Flashing indication of a character represents two identical characters. Alternating indication of two characters represents two different characters.

Register name	Block word	Field bits	Field name	Field description
		9	Input D1	0: Low 1: High
		10	Input C2	0: Low 1: High
		11	Input C1	0: Low 1: High
		12	Input B2	0: Low 1: High
		13	Input B1	0: Low 1: High
		14	Input A2	0: Low 1: High
		15	Input A1	0: Low 1: High
		16 ... 31	Speed	–2000 ... 2000 [cm/s] (two's-complement representation) 0x0000: Speed is not evaluated. **In compatibility mode:** 0x7FFF: Speed is not evaluated. Other: n/u (Consider speed valid flag!)
Output states	5	0	State of OSSDs	0: Deactivated (red) 1: Activated (green)
		1	State of warning output or aux 3	0: Deactivated (red) 1: Activated (green)
		2 ... 3	State of reset required output or aux 2	0: Deactivated (off) 1: Toggling slowly (1 Hz) 2: Toggling fast (4 Hz) 3: Activated (on)
		4 ... 5	State of error/weak output or aux 1	0: Deactivated (off), not configured or contamination error 1: Toggling slowly (1 Hz), contamination warning 2: Toggling fast (4 Hz), lockout 3: Activated (on), configured and no lockout or contamination error
		6 ... 7	n/u	n/u
		8	Field A	Intrusion detected by field evaluation A. 0: Intrusion detected. 1: No intrusion detected.
		9	Field B	Intrusion detected by field evaluation B. 0: Intrusion detected. 1: No intrusion detected.
		10	Field C	Intrusion detected by field evaluation C. 0: Intrusion detected. 1: No intrusion detected.

Register name	Block word	Field bits	Field name	Field description
		11	Field D	Intrusion detected by field evaluation D. 0: Intrusion detected. 1: No intrusion detected.
		12	Reset required field A	Reset required by field evaluation A. 0: No reset required. 1: Reset required.
		13	Reset required field B	Reset required by field evaluation B. 0: No reset required. 1: Reset required.
		14	Reset required field C	Reset required by field evaluation C. 0: No reset required. 1: Reset required.
		15	Reset required field D	Reset required by field evaluation D. 0: No reset required. 1: Reset required.
Speed data	6 ... 7	0 ... 15	Speed inc 1	Speed of Incremental Encoder 1: –2000 ... 2000 [cm/s] (two's-complement representation)
		16 ... 31	Speed inc 2	Speed of Incremental Encoder 2: –2000 ... 2000 [cm/s] (two's-complement representation)
	8	0	Input E2	0: Low 1: High
		1	Input E1	0: Low 1: High
		2 ... 14	n/u	n/u
		15	Speed status	Status of speed 0: The speed information is invalid. 1: The speed information is valid.
Error info	9	0 ... 15	Error code	Lockout error or info code
Field evaluation A	10	0 ... 5	Monitoring field number	0 ... 63: Monitoring field number of field assigned to field evaluation A
		6 ... 7	Monitoring field type	0: Protective field 1: Warning field 2: Contour field 3: Inactive field. With the inactive field selected no monitoring field is evaluated and the field status is set as configure with Expert application configuration block to free (MutingField) or intrusion (BlockingField)

Register name	Block word	Field bits	Field name	Field description
		8 ... 15	Multiple scan evaluation	0 ... 255: Number of scans that an object has to be detected as intrusion to set the status of the field to “intruded”.
Field evaluation B ... D	11 ... 13	See field evaluation A.		
Pulse 0	14	0 ... 12	Distance	Distance [cm]
		13	Status flag 1	CMS variants: Reflector detected. Non-CMS variants: Measurement was glared.
		14	Status flag 2	Intrusion detected in protective field (field evaluation A).
		15	Status flag 3	Firmware < 2.10: Intrusion detected in warning field. Firmware ≥ 2.10: n/u
Pulse 1 ... 540	15 ... 554	See pulse 0.		

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