readme.md for @fin.cx/skr

> **Enterprise-grade German accounting standards implementation for SKR03 and SKR04**
> Rock-solid double-entry bookkeeping with MongoDB persistence, e-invoice integration, and full TypeScript support

□□ Why @fin.cx/skr?

Building compliant German accounting software? You've come to the right place! This module provides a **complete, type-safe implementation** of the German standard charts of accounts (Standardkontenrahmen) SKR03 and SKR04, the backbone of professional accounting in Germany.

□□ What makes it awesome?

- □□ **Enterprise-Ready**: Production-tested implementation following HGB/GoBD standards
- ⚡ **Lightning Fast**: MongoDB-powered with optimized indexing and real-time balance updates
- □□ **Type-Safe**: Full TypeScript support with comprehensive type definitions
- □□ **Developer-Friendly**: Intuitive API that makes complex accounting operations simple
- □□ **Real-time Reporting**: Generate financial statements on-the-fly
- □□ **Transaction Safety**: Built-in double-entry validation and automatic reversals
- □ **Battle-Tested**: 65+ comprehensive tests covering all edge cases
- □□ **SKR Validation**: Automatic validation against official SKR standards
- □□ **E-Invoice Support**: Full XRechnung/ZUGFeRD integration for modern invoice processing
- □□ **Cryptographic Security**: Merkle tree and digital signature support for audit trails
- □□ **PDF Export**: Professional PDF report generation with customizable templates

□□ Installation

```
# Using npm
npm install @fin.cx/skr
```

```
# Using pnpm (recommended)
pnpm add @fin.cx/skr

# Using yarn
yarn add @fin.cx/skr
```

□□ Quick Start

Basic Setup

```
import { SkrApi } from '@fin.cx/skr';

// Initialize the API
const api = new SkrApi({
  mongoDbUrl: 'mongodb://localhost:27017',
  dbName: 'accounting' // optional, defaults to 'skr_accounting'
});

// Choose your SKR standard (SKR03 or SKR04)
await api.initialize('SKR03');
```

□□ Posting Transactions

```
// Simple transaction posting
const transaction = await api.postTransaction({
  date: new Date(),
  debitAccount: '1200',  // Bank account
  creditAccount: '8400', // Revenue account
  amount: 1190.00,
  description: 'Invoice #2024-001 payment received',
  reference: 'INV-2024-001',
  vatAmount: 190.00
});
```

```
// Complex journal entry with multiple lines
const journalEntry = await api.postJournalEntry({
  date: new Date(),
  description: 'Monthly salary payments',
  reference: 'SAL-2024-03',
  lines: [
    { accountNumber: '6000', debit: 5000.00, description: 'Gross salary' },
    { accountNumber: '6100', debit: 1000.00, description: 'Social security employer' },
    { accountNumber: '1800', credit: 1500.00, description: 'Tax withholding' },
    { accountNumber: '1200', credit: 4500.00, description: 'Net payment' }
  ]
});
```

□□ E-Invoice Integration

```
// Import electronic invoices (XRechnung/ZUGFeRD)
const invoiceData = await api.importInvoice(xmlContent, {
  format: 'xrechnung',
  validateSchema: true,
  checkDuplicates: true
});

// Automatically book invoice to accounting
const booking = await api.bookInvoice(invoiceData.invoiceId, {
  autoDetectAccounts: true,
  splitVAT: true,
  createPaymentSchedule: true
});

// Export invoice in various formats
const xRechnung = await api.exportInvoice(invoiceId, {
  format: 'xrechnung',
  version: '3.0',
  includeAttachments: true
});

// Search and filter invoices
const invoices = await api.searchInvoices({
```

```
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31'),
  status: 'booked',
  minAmount: 100,
  customerVATId: 'DE123456789'
});

// Generate compliance reports
const complianceReport = await api.createInvoiceComplianceReport({
  period: '2024-Q1',
  includeValidation: true,
  includeStatistics: true
});
```

□□ Generating Financial Reports

```
// Trial Balance (Summen- und Saldenliste)
const trialBalance = await api.generateTrialBalance({
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31')
});

// Income Statement (GuV - Gewinn- und Verlustrechnung)
const incomeStatement = await api.generateIncomeStatement({
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31')
});

// Balance Sheet (Bilanz)
const balanceSheet = await api.generateBalanceSheet({
  date: new Date('2024-12-31')
});

// General Ledger Export
const generalLedger = await api.generateGeneralLedger({
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31')
});
```

```
// Cash Flow Statement
const cashFlow = await api.generateCashFlowStatement({
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31')
});
```

□□ Advanced Export Features

```
// Export complete annual closing package (Jahresabschluss)
const jahresabschluss = await api.exportJahresabschluss({
  year: 2024,
  includeReports: ['balance_sheet', 'income_statement', 'cash_flow'],
  format: 'structured', // 'structured' | 'pdf' | 'csv'
  language: 'de',
  signatureRequired: true
});

// Generate PDF reports with professional formatting
const pdfReports = await api.generatePdfReports({
  reports: ['trial_balance', 'income_statement', 'balance_sheet'],
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31'),
  companyInfo: {
    name: 'Mustermann GmbH',
    address: 'Hauptstraße 1, 10115 Berlin',
    taxNumber: 'DE123456789',
    registrationNumber: 'HRB 12345'
  },
  outputPath: './reports/',
  template: 'professional' // Custom templates available
});

// Export with cryptographic signatures for audit trail
const signedExport = await api.signExport({
  data: jahresabschluss,
  privateKey: privateKeyPEM,
  certificate: certificatePEM,
```

```
  includeTimestamp: true,
  hashAlgorithm: 'SHA256'
});

// Detailed account data export
const accountExport = await api.exportAccountData({
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31'),
  format: 'detailed', // 'summary' | 'detailed' | 'tree'
  includeTransactions: true,
  includeBalances: true
});

// Balance history export for analysis
const balanceHistory = await api.exportBalanceData({
  accounts: ['1200', '1000', '8400'],
  interval: 'monthly', // 'daily' | 'weekly' | 'monthly' | 'quarterly'
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31'),
  includeRunningTotals: true
});

// Ledger export with filtering options
const ledgerExport = await api.exportLedgerData({
  accounts: ['1000-1999'], // Range support
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31'),
  includeReversals: false,
  groupByAccount: true,
  format: 'journal' // 'journal' | 'T-account' | 'chronological'
});
```

□□ Core Features

Account Management

```
// Create custom accounts
const account = await api.createAccount({
  accountNumber: '1299',
  accountName: 'PayPal Business',
  accountClass: 1,
  accountType: 'asset',
  description: 'PayPal business account for online payments',
  isActive: true
});

// Batch create multiple accounts for efficiency
const accounts = await api.createBatchAccounts([
  { accountNumber: '1298', accountName: 'Stripe Account', accountClass: 1, accountType:
'asset' },
  { accountNumber: '1297', accountName: 'Wise Business', accountClass: 1, accountType: 'asset'
}
]);

// Search accounts by name or number
const accounts = await api.searchAccounts('bank');

// Get account with full details
const account = await api.getAccount('1200');

// Update account information
await api.updateAccount('1200', {
  accountName: 'Main Business Bank Account',
  description: 'Primary operating account'
});

// Get account balance with running totals
const balance = await api.getAccountBalance('1200');
console.log(`Balance: €${balance.balance}`);
console.log(`Total Debits: €${balance.debitTotal}`);
console.log(`Total Credits: €${balance.creditTotal}`);

// List accounts by classification
const assetAccounts = await api.getAccountsByType('asset');
const class4Accounts = await api.getAccountsByClass(4);
```

```
// Paginated account access for large datasets
const pagedAccounts = await api.getAccountsPaginated({
  page: 1,
  limit: 50,
  sortBy: 'accountNumber',
  sortOrder: 'asc'
});
```

Transaction Management

```
// Get transaction by ID
const transaction = await api.getTransaction(transactionId);

// Get transaction history with filtering
const transactions = await api.listTransactions({
  accountNumber: '1200',
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31'),
  minAmount: 100,
  maxAmount: 10000
});

// Get all transactions for a specific account
const accountTransactions = await api.getAccountTransactions('1200', {
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31')
});

// Reverse transactions (Storno)
const reversal = await api.reverseTransaction(transactionId);

// Reverse complex journal entries
const journalReversal = await api.reverseJournalEntry(journalEntryId);

// Batch processing for performance
const batchResults = await api.postBatchTransactions([
  { date: new Date(), debitAccount: '1200', creditAccount: '8400', amount: 100 },
```

```
  { date: new Date(), debitAccount: '1200', creditAccount: '8400', amount: 200 },
  { date: new Date(), debitAccount: '1200', creditAccount: '8400', amount: 300 }
]);

// Paginated access for large datasets
const pagedTransactions = await api.getTransactionsPaginated({
  page: 1,
  limit: 50,
  sortBy: 'date',
  sortOrder: 'desc'
});

// Find unbalanced transactions for audit
const unbalanced = await api.getUnbalancedTransactions();
```

□□ SKR03 vs SKR04: Which One to Choose?

SKR03 - Process Structure Principle (Prozessgliederungsprinzip)

Best for: □□ Trading companies, □□ Service providers, □□ Retail businesses

- Accounts organized by **business process flow**
- Easier mapping to operational workflows
- Natural progression from purchasing → inventory → sales
- Popular with small to medium enterprises

SKR04 - Financial Classification Principle (Abschlussgliederungsprinzip)

Best for: □□ Manufacturing companies, □□ Large corporations, □□ Public companies

- Accounts organized by **financial statement structure**

- Direct mapping to balance sheet and P&L positions
- Simplified financial reporting and analysis
- Preferred by auditors and financial institutions

□□ Account Structure

Both SKR standards follow the same 4-digit hierarchical structure:

```
[0-9]    → Account Class (Kontenklasse)
 [0-9]   → Account Group (Kontengruppe)
  [0-9]  → Account Subgroup (Kontenuntergruppe)
   [0-9] → Individual Account (Einzelkonto)
```

Account Classes Overview

Class	SKR03 Description	SKR04 Description	Type
0	Fixed Assets (Anlagevermögen)	Fixed Assets	Asset
1	Current Assets (Umlaufvermögen)	Financial & Current Assets	Asset
2	Equity (Eigenkapital)	Expenses Part 1	Equity/Expense
3	Liabilities (Fremdkapital)	Expenses Part 2	Liability/Expense
4	Operating Income (Betriebliche Erträge)	Revenues Part 1	Revenue
5	Material Costs (Materialaufwand)	Revenues Part 2	Expense/Revenue
6	Operating Expenses (Betriebsaufwand)	Special Accounts	Expense
7	Other Costs (Weitere Aufwendungen)	Cost Accounting	Expense
8	Income (Erträge)	Free for Use (Custom)	Revenue
9	Closing Accounts (Abschlusskonten)	Equity & Closing	System

□□ Advanced Features

Period Management

```
// Close accounting period with automatic adjustments
await api.closePeriod('2024-01', {
  performYearEndAdjustments: true,
  generateReports: true
});

// Recalculate all account balances
await api.recalculateBalances();
```

Data Import/Export

```
// Import accounts from CSV
const importedCount = await api.importAccountsFromCSV(csvContent);

// Export accounts to CSV
const csvExport = await api.exportAccountsToCSV();

// Export to DATEV format (for tax advisors)
const datevExport = await api.exportToDATEV({
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31')
});

// Export reports to CSV
const reportCsv = await api.exportReportToCSV('income_statement', {
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31')
});
```

Validation & Integrity

```
// Find unbalanced transactions
const unbalanced = await api.getUnbalancedTransactions();
```

```
// Validate double-entry before posting
const isValid = await api.validateDoubleEntry({
  debitAccount: '1000',
  creditAccount: '8400',
  amount: 100
});

// The API automatically validates all journal entries
// Will throw error if entry is unbalanced
try {
  await api.postJournalEntry({
    date: new Date(),
    lines: [
      { accountNumber: '1000', debit: 100 },
      { accountNumber: '8400', credit: 99 } // Unbalanced!
    ]
  });
} catch (error) {
  console.error('Journal entry is not balanced!');
}
```

Invoice Processing & Compliance

```
// Get invoice statistics and analytics
const stats = await api.getInvoiceStatistics({
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31'),
  groupBy: 'month',
  includeVATAnalysis: true
});

// Generate invoices programmatically
const invoice = await api.generateInvoice({
  invoiceNumber: 'INV-2024-001',
  date: new Date(),
  dueDate: new Date(Date.now() + 30 * 24 * 60 * 60 * 1000),
  seller: {
    name: 'Your Company GmbH',
```

```
    vatId: 'DE123456789',
    address: 'Hauptstraße 1, 10115 Berlin'
  },
  buyer: {
    name: 'Customer AG',
    vatId: 'DE987654321',
    address: 'Kundenweg 5, 80331 München'
  },
  lines: [
    {
      description: 'Consulting Services',
      quantity: 10,
      unitPrice: 100,
      vatRate: 19
    }
  ]
});

// Validate invoice compliance
const validation = await api.validateInvoice(invoice, {
  standard: 'xrechnung',
  checkBusinessRules: true,
  checkVATRules: true
});
```

Utility Functions

```
// Get SKR type description for account classes
const classDesc = api.getAccountClassDescription(4);
// Returns: "Operating Income (SKR03)" or "Revenues Part 1 (SKR04)"

// Get current SKR type
const skrType = api.getSKRType(); // Returns: 'SKR03' or 'SKR04'
```

□□ Type Safety

Full TypeScript support with comprehensive type definitions:

```
import type {
  TSKRType,
  IAccountData,
  ITransactionData,
  IJournalEntry,
  IJournalEntryLine,
  ITrialBalanceReport,
  IIncomeStatement,
  IBalanceSheet,
  IAccountFilter,
  ITransactionFilter,
  IPaginationParams,
  IAccountBalance,
  ICashFlowStatement,
  IGeneralLedger,
  IInvoice,
  IInvoiceLine,
  IInvoiceParty,
  IBookingRules,
  IValidationResult
} from '@fin.cx/skr';

// All operations are fully typed
const account: IAccountData = {
  accountNumber: '1200',
  accountName: 'Bank Account',
  accountClass: 1,
  accountType: 'asset',
  skrType: 'SKR03',
  isActive: true
};

// TypeScript will catch errors at compile time
const filter: IAccountFilter = {
  accountType: 'asset',
  isActive: true,
  accountClass: 1
};
```

```
// Journal entries are validated at type level
const journalEntry: IJournalEntry = {
  date: new Date(),
  description: 'Year-end closing',
  lines: [
    { accountNumber: '8400', debit: 0, credit: 1000 },
    { accountNumber: '9000', debit: 1000, credit: 0 }
  ]
};
```

□□ Real-World Example: Complete Annual Closing

Here's how to perform a complete Jahresabschluss (annual financial closing):

```
import { SkrApi } from '@fin.cx/skr';

async function performJahresabschluss() {
  const api = new SkrApi({
    mongoDbUrl: process.env.MONGODB_URL!,
    dbName: 'company_accounting'
  });

  await api.initialize('SKR04'); // Using SKR04 for better reporting structure

  // 1. Post year-end adjustments
  const adjustments = await api.postJournalEntry({
    date: new Date('2024-12-31'),
    description: 'Jahresabschlussbuchungen',
    reference: 'JA-2024',
    lines: [
      // Depreciation (AfA)
      { accountNumber: '3700', debit: 10000, description: 'AfA auf Anlagen' },
      { accountNumber: '0210', credit: 10000, description: 'Wertberichtigung Gebäude' },

      // Provisions (Rückstellungen)
```

```
    { accountNumber: '3500', debit: 5000, description: 'Bildung Rückstellungen' },
    { accountNumber: '0800', credit: 5000, description: 'Sonstige Rückstellungen' },

    // VAT clearing
    { accountNumber: '1771', debit: 19000, description: 'USt-Saldo' },
    { accountNumber: '1571', credit: 17000, description: 'Vorsteuer-Saldo' },
    { accountNumber: '1700', credit: 2000, description: 'USt-Zahllast' }
  ]
});

// 2. Generate comprehensive annual closing package
const jahresabschluss = await api.exportJahresabschluss({
  year: 2024,
  includeReports: ['balance_sheet', 'income_statement', 'cash_flow', 'trial_balance'],
  format: 'pdf',
  language: 'de',
  signatureRequired: true,
  companyInfo: {
    name: 'Mustermann GmbH',
    address: 'Hauptstraße 1, 10115 Berlin',
    taxNumber: 'DE123456789',
    registrationNumber: 'HRB 12345'
  }
});

// 3. Generate individual reports for analysis
const incomeStatement = await api.generateIncomeStatement({
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31')
});

const balanceSheet = await api.generateBalanceSheet({
  date: new Date('2024-12-31')
});

const cashFlow = await api.generateCashFlowStatement({
  dateFrom: new Date('2024-01-01'),
  dateTo: new Date('2024-12-31')
});
```

```
  // 4. Export for tax advisor in DATEV format
  const datevExport = await api.exportToDATEV({
    dateFrom: new Date('2024-01-01'),
    dateTo: new Date('2024-12-31')
  });

  // 5. Create signed export for audit trail
  const signedExport = await api.signExport({
    data: jahresabschluss,
    privateKey: process.env.PRIVATE_KEY!,
    certificate: process.env.CERTIFICATE!,
    includeTimestamp: true
  });

  // 6. Close the period
  await api.closePeriod('2024-12', {
    performYearEndAdjustments: true,
    generateReports: true
  });

  console.log('□□Jahresabschluss 2024 Complete!');
  console.log(`□□Umsatz: €${incomeStatement.totalRevenue.toLocaleString('de-DE')}`);
  console.log(`□□Aufwendungen: €${incomeStatement.totalExpenses.toLocaleString('de-DE')}`);
  console.log(`□□Jahresergebnis: €${incomeStatement.netIncome.toLocaleString('de-DE')}`);
  console.log(`□□Bilanzsumme: €${balanceSheet.assets.totalAssets.toLocaleString('de-DE')}`);
  console.log(`□□Cash Flow: €${cashFlow.netCashFlow.toLocaleString('de-DE')}`);
  console.log(incomeStatement.netIncome > 0 ? '□ Gewinn!' : '□□Verlust');

  await api.close();
}

performJahresabschluss().catch(console.error);
```

□□ API Reference

Main Classes

Class	Description
`SkrApi`	Main API entry point for all operations
`ChartOfAccounts`	Account management and initialization
`Ledger`	General ledger and transaction posting with SKR validation
`Reports`	Financial reporting and exports
`Account`	Account model with balance tracking
`Transaction`	Double-entry transaction model
`JournalEntry`	Complex multi-line journal entries
`InvoiceAdapter`	XRechnung/ZUGFeRD invoice processing
`InvoiceBookingEngine`	Automatic invoice to accounting booking
`InvoiceStorage`	Invoice persistence and search

Key Methods

Method	Description
`initialize(skrType)`	Initialize with SKR03 or SKR04
`postTransaction(data)`	Post a simple two-line transaction
`postJournalEntry(data)`	Post complex multi-line journal entry
`postBatchTransactions(transactions)`	Post multiple transactions efficiently
`reverseTransaction(id)`	Create reversal (Storno) entry
`reverseJournalEntry(id)`	Reverse complex journal entries
`generateTrialBalance(params)`	Generate Summen- und Saldenliste
`generateIncomeStatement(params)`	Generate GuV (P&L) statement
`generateBalanceSheet(params)`	Generate Bilanz (balance sheet)
`generateCashFlowStatement(params)`	Generate cash flow statement
`generateGeneralLedger(params)`	Generate complete general ledger
`exportToDATEV(params)`	Export DATEV-compatible data
`exportJahresabschluss(params)`	Export complete annual closing package
`generatePdfReports(params)`	Generate professional PDF reports
`signExport(data)`	Create cryptographically signed exports
`importInvoice(data, options)`	Import XRechnung/ZUGFeRD invoices
`bookInvoice(invoiceId, rules)`	Book invoice to accounting

Method	Description
`exportInvoice(id, options)`	Export invoice in various formats
`searchInvoices(filter)`	Search and filter invoices
`closePeriod(period, options)`	Close accounting period
`recalculateBalances()`	Recalculate all account balances
`validateDoubleEntry(data)`	Validate transaction before posting
`getUnbalancedTransactions()`	Find integrity issues
`createBatchAccounts(accounts)`	Create multiple accounts at once

□□ Why Developers Love It

- □□ **Zero Configuration**: Pre-configured SKR03/SKR04 accounts out of the box
- □□ **Automatic Validation**: Never worry about unbalanced entries or wrong account types
- □□ **Real-time Analytics**: Instant financial insights with live balance updates
- □□ **SKR Compliance**: Validates against official SKR standards automatically
- □□ **High Performance**: Optimized MongoDB queries and batch operations
- □□ **German Compliance**: Full HGB/GoBD compliance built-in
- □□ **Type Safety**: Complete TypeScript definitions prevent runtime errors
- □□ **Smart Validation**: Warns about non-standard accounts and type mismatches
- □□ **E-Invoice Ready**: Native XRechnung/ZUGFeRD support for modern workflows
- □□ **Audit-Proof**: Cryptographic signatures and Merkle trees for tamper-proof records
- □□ **Professional Reports**: Generate PDF reports that impress auditors and stakeholders

□□ Requirements

- **Node.js** >= 18.0.0
- **MongoDB** >= 5.0
- **TypeScript** >= 5.0 (for development)

□□ Testing

The module includes comprehensive test coverage with real-world scenarios:

```
# Run all tests
pnpm test

# Run specific test suites
pnpm test test/test.skr03.ts         # SKR03 functionality
pnpm test test/test.skr04.ts         # SKR04 functionality
pnpm test test/test.jahresabschluss.skr03.ts  # Annual closing SKR03
pnpm test test/test.jahresabschluss.skr04.ts  # Annual closing SKR04
pnpm test test/test.invoice.ts       # Invoice processing
pnpm test test/test.export.ts        # Export functionality
```

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Revision #5
Created 2026-03-28 10:49:19 UTC by foss.global Team
Updated 2026-03-28 12:15:14 UTC by foss.global Team